THE

ELECTRICAL REVIEW.

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THE

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ELECTRIC RAILWAY MATTERS.

WE had thoughts of heading this article "Electric Railway *Progress*," but that would have been hardly correct if applied to all that we have to record in the few comments which follow. For example, what is the measure of progress that is being made with that everlasting question of the electrical equipment of the "underground" railways of London? During the past few weeks the daily Press has been a battleground for the rival parties, already at loggerheads, to carry on their quarrels still further in the view of the public by squabbling as to who is, and who is not, responsible for the delays. We are not at all surprised to find that the Press and the public are becoming weary of this sort of thing, and are longing for October 7th, when the Hon. A. Lyttleton, K.C., M.P., presides over the Board of Trade tribunal to hear all that may be said for and against the Ganz system and the "Yerkes system"—whatever that may be. We refrain from expressing any opinion as to the respective merits of the arguments or systems of the two parties, and join with the over-wearied public in clamouring for a settlement of some kind without further delay.

Turning to another project altogether, it is announced that the contract for the electrical conversion of the Mersey railways has gone to the Westinghouse Company, under terms which are detailed in another column of this issue. It is agreed that the work shall be completed within 18 months, and the contractors guarantee that enormous economies will be effected in the working expenses. Figuring now at 1s. 3d. per train-mile of steam traction, they are to be reduced to 6¾d. with electrical working.

There is a scheme, for which surveys have recently been made and an excellent route of 47 miles selected, for a high speed electric railway between London and Brighton; 120 miles an hour is spoken of quite glibly, as though it had been done a dozen times over in railway working. We have heard of London—Brighton electric railway schemes in years gone by. They have remained on paper so far. May the present scheme meet with better success. So far it is a paper project which has not even troubled a Parliamentary Committee, and, therefore, is hardly worth discussing from a practical point of view just yet. The opposition of the existing lines will have to be reckoned with; Mr. Staats Forbes seems to regard the proposition as a huge joke, and he pooh-poohs it accordingly. What other course could so happy and contented a man as Mr. Forbes be expected to adopt?

In the domain of high speed electric traction there have been several interesting points raised of late. Herr Lasche's paper at the Glasgow Engineering Congress is well within our readers' minds, and the efforts of the A.E.G. are pretty common knowledge. Messrs. Siemens & Halske and other German firms are also devoting themselves to the question

in a very thorough manner, and under the august patronage of the German Emperor and the military authorities, something of practical service may be forthcoming before very long.

So far as our own high-speed experiment on the Behr monorail system is concerned, there are no signs of undue haste in carrying the powers, already obtained, into effect. There are still many preliminaries to be arranged, and there is talk in the Manchester press of the necessity for promoting yet another Bill to enable the company to carry out the agreement with the Salford Corporation. It is said that there is some reason for hoping that one section, some of the generating plant at Warrington, and a couple of the cars, will be completed by the spring of 1903; but we are told that "we shall probably have to wait till the year 1905 has dawned before we can enjoy the luxuries of a 20-minutes' journey from Manchester to Liverpool." Will it be possible by then?

It is stated that the Prussian Railway Administration has reported upon the electric railway experiments on the Berlin-Wansee line and elsewhere. While electricity is considered to have many advantages, it is said to compare very unfavourably with steam in regard to cost. This is a rather remarkable statement in view of the results on London electric railways, and the figures just quoted by us in respect to the Mersey contract.

With the opening of November will come the throwing open for public traffic of the Islington section of the City and South London Railway Company—a name which looks as though it might be bettered now that the northern district is touched. Eleven new and enlarged trains "made in England" will be introduced; they are four-coach double compartment trains, and a special feature is the raising of the roof in the centre to permit of the introduction of ornamental ventilators. Improvements are being effected in the lighting of the trains throughout the entire system.

From Sweden comes the news that the Government there is considering plans of working the State railways electrically, instead of by steam, waterfalls, which are very plentiful in that country, being utilised in connection therewith. From America we learn that the contracts for the construction and electrical equipment of the New York Rapid Transit Railroad have been let. The equipment will comprise 48 Babcock boilers, eight 7,500-H.P. Allis engines (two component engines working on one shaft), direct connected to 5,000 KW. generators of the revolving field fly-wheel alternator type.

We ought not to forget the scheme which was discussed at Glasgow, for an electric railway to run through a tunnel to Ireland. The project is very much in the air at present, and requires such financial support as is not likely to be forthcoming yet awhile. When the tunnel itself is on a fair way to completion, we will again refer to the electrical project.

The above remarks constitute a brief summary of some of the questions which have arisen during the past week or two in connection with electric railway development. It may not be complete, nor of much practical engineering service so far as details of the different undertakings are concerned, but it will serve to show generally what is doing.

Dielectric Strength.

THE relation between the thickness of the dielectric on a cable core and the potential difference required to disrupt it, involves so many variables that it has hitherto been extremely difficult to express it by any simple formula. Given four or five observed values, it is an easy matter to find an equation to fit the corresponding curve, but no general law has been discovered. The problem is sufficiently difficult in cases where the potential applied is from a battery; in alternate current tests on cables the question involves the effects of self-induction and capacity, the distribution of potential is extremely complicated, and to generalise on the results is, as a rule, a disappointing occupation. There has been a great deal written on this subject during the past four years in America, especially in regard to paper dielectrics; it was keenly discussed 10 years ago at the Institution of Electrical Engineers; it cropped up again during the reading of Mr. Mordey's recent paper, and yet again when Mr. O'Gorman compiled his lengthy contribution. But that the problem is not yet solved is obvious from an article by Mr. C. Baur in the *Electrician* of September 6th. Mr. Baur has a little formula of his own which certainly appears to come very near to the mark, but we confess that the evidence he puts forward in revealing the discrepancies resulting from the use of the formulæ of others, makes us more than cautious in accepting any generalisation, especially an empirical one, even from himself. He quotes, for instance, from Mr. O'Gorman's paper as follows:—"We may suppose the insulating material has a *constant volt-resisting quality* per centimetre thickness, measured between plane surfaces. Trowbridge (1898) has proved this true for large thicknesses of air; and T. Gray (1898) for all thicknesses of paraffined paper. It is not true for small thicknesses of substances like paper impregnated with oil, empire cloth, mica, &c., but the law is known, having been investigated by T. Gray and others." If the law is known, it appears to us to be rather a pity that nature should be found so frequently averse from it. Mr. Baur is of opinion that it does not hold even in the case of air. The equation suggested by Mr. Baur when applied to the observed volts and dielectric thicknesses gives some very satisfactory results. If d is the dielectric thickness of a cable core measured in millimetres, v the potential difference of the alternating current measured in volts, and c a constant, his suggested formula is

$$v = c\, d^{\frac{3}{4}}.$$

This he shows to be fairly representative for impregnated jute for thicknesses $d = 3$ to $d = 24$, c being 2,200. It is similarly applicable within fair limits of accuracy to calico impregnated with india-rubber ($c = 2{,}200$), to air ($c = 3{,}300$), to mica ($c = 58{,}000$), and to vulcanised india-rubber ($c = 10{,}000$). If these results can be confirmed, and this empirical law established, it will be of great value to electrical engineers. We commend it to the consideration of the directors of the National Physical Laboratory. In carrying out such tests, the difficulty will be to procure the substances free from foreign particles and bubbles. And even if the law is proved to be sufficiently accurate under such conditions, great factors of safety would have to be allowed in the commercial adoption of it. Once established, the law would be of service in cable specifications, for in a great many instances dielectric strength is only second in importance to dielectric resistance.

Sedgley and Wolverhampton.—The new electric tramway line from Sedgley to the boundary of the borough of Wolverhampton is now completed. Trial trips have taken place, and the official inspection will be made shortly.

ENGLISH AND AMERICAN RAILWAY SIGNALLING.

By J. PIGG.

(*Continued from page* 505.)

The track batteries are usually of the gravity Daniell type, and it is found that from two of these in parallel the best results are obtained. The batteries are usually buried in the ground at such a depth as will prevent their freezing. Naturally, with such an imperfectly insulated circuit as is offered by a pair of rails, the track relay must be of low resistance, and the relay be capable of working with a wide range in the strength of the current. It is also necessary that the circuit formed by the rails should be of as low a resistance as possible, and to ensure that joints in the rails do not increase the resistance appreciably, they are each bonded with two No. 8 Brown & Sharpe's gauge galvanised iron wires.

The controlled manual system provides special mechanism by which the lever of, say, "A's" signal is locked in the danger position by the armature of an electro-magnet controlled and operated by "B." A special circuit is erected between those points for the operation of the apparatus, and at each place an indicator is provided, which shows "clear" when neither has given permission to lower the other's signal, and "Blocked" when one of them has done so. At "A" the special circuit includes the electro-magnet only, the armature of which locks the signal lever. At "B" the circuit is completed through the tongue of a relay operated by the track circuit relay, and also through a "plunger" or circuit breaker. The effect of "plunging" is to break down the special circuit by which the lock is operated, and it remains in this condition until the train signalled passes on to the track circuit, which, of course, is outside of the "block." Until the train has passed on to the track circuit, and re-made the locking circuit, further use of the plunger has no effect, and the operator at "B" is thus prevented from releasing "A's" signal for a second train, even if he inadvertently goes through the operation of plunging. From what has already been stated with reference to the cyclic nature of the operations in the later forms of the controlled manual system, it is obvious that the locking circuit is not completely re-made until the signal at "B" has been replaced in the danger position behind the train which has just passed out of the section.

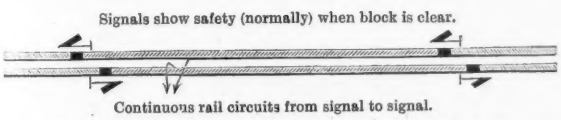


Fig. 9.—Diagram of Automatic Signals under Continuous Control of Trains.

The apparent safety of the controlled manual system to those which it has superseded is ascribed to the substitution of automatic control for manual control. The function of the operator is to furnish the energy for *operating* a block signal system that is primarily *controlled* automatically by the train passing through the block. Properly designed and efficiently maintained mechanism is considered preferable as a means of control, to the control of man with all the other interests and weaknesses inseparable from his existence, which tend to lower his efficiency as a machine.

From the adoption of the track circuit as a means of controlling the operator's movements, to its use for the automatic actuation of the signals, and the protection of the trains, was an obvious step, and the reasoning employed to justify such a change is plain. "If the substitution of automatic devices for the control of a system formerly under human control and operation produced such beneficial results, why, one naturally asks, should not the introduction of automatic mechanisms for its operation produce like benefits?" The system is merely an expansion of the track circuit from signal to signal with the addition of means for operating the signals. "It," the automatic system, "is constantly on duty, requires no relief substitute, never goes on strike nor tires of its job, never sleeps, gets drunk, or deserts its pals, and never misconstrues its orders." Such is the eulogy of the automatic system by an ardent advocate of its use. The other side of the shield is as follows:—"Automatic signals are incapable of detecting and reporting disobedience of their warnings by enginemen, they are incapable of reporting and correcting derangements of their mechanism, they give no assurance of detecting wrecks, landslides, wash-outs, or of other dangers to traffic that are at least liable to detection by the operators of manual systems." Again, "the ideal system is one in which the train in a block has control of the signals governing the entrance to that block." "The (automatic) system affords means of detecting misplaced switches in the block, of failure of cars on side tracks to stand clear of running line, has frequently detected broken rails and obstructions in switches, it affords opportunity for trackmen to protect blocks during emergencies, and for protection during repairs." "Operators for such a system are superfluous, and could only be of use in case of derangement." "Railroad officials are universally awakening to the possibilities of automatic signals, and that wages are better utilised in obtaining automatic operation, which the writer considers would result in a better service." "Failures with the automatic system have been largely due to insufficient force."

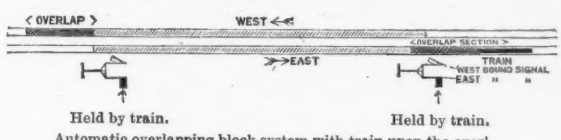


Fig. 10.—Diagram of Overlap System of Automatic Signalling.

Such are some of the arguments adduced by advocates of automatic signalling in favour of that system, and it must be confessed that many of them are of a forcible character. If certainty of action, better service, and economy are the results of the adoption of the automatic system, its advocates are justified in their eulogy, extravagant as some of the claims seem to be.

An application of the automatic system is that known as the "overlap" (fig. 10). In this arrangement the signal at the entrance to a section is kept at danger by the train in the block until it has passed the signal governing entrance into the succeeding block, a certain pre-determined distance, both signals being held at danger during the time the train is on the overlap section. Fig. 11 shows the theoretical arrangement of the independent block system, with the use of a supplementary signal to those already referred to, which is known as the "distant," or cautionary signal. This signal is essentially a repeater, in that it indicates the position of the "home" or stop signal at the entrance to the block ahead. The overlap system, since it ensures the placing of two signals to danger behind a train after it has passed into

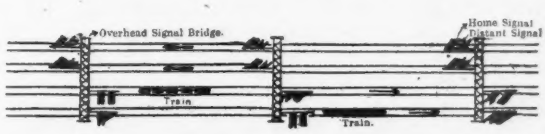


Fig. 11.—Non-Overlapping Block System of Automatic Signals Applied to Four-Track Road using Distant Signals.

the next block ahead, is considered to minimise the risk of collision with a succeeding train which has passed the first of the two signals referred to. This action is accounted for by the rule that, where automatic signals are in use, trains may pass them, when at danger, at caution, after a stop of one or more minutes, as the rule requires. Hence the overlap system enables two signals to be kept at danger behind the first train until the latter is some distance within the protection of the last one. The disadvantage is that drivers may be tempted to pass signals carelessly when at danger, when aware that the previous train may be actually out of the block governed by the signal. On the other hand, where

the "distant" signal is used, whilst the "home" signal of a section advises the engineman of the occupation or otherwise of that block, the distant advises him also of the condition of the next block ahead. If only one signal, the "home," is off, the first section only is clear. If both the "home" and the "distant" are off, two sections ahead are clear.

The actual operation of the signals has been effected in a variety of ways. In some cases disc signals were operated by coil springs, or weights driving trains of gear wheels, the release being effected by electro-magnets, which, again, were operated by currents set up by treadles. Other treadles gave motion to magnetos, some compressed air, some compressed heavy coil or spiral springs, and others raised heavy weights. In other cases, in present practice, the signals are operated by compressed air separately provided and supplied, as in the Westinghouse system, or by the aid of electric motors supplied from primary batteries as in the Hall system.

In the Westinghouse system the track relay governs the valves of a compressed air motor through the medium of an electro-magnet mounted on the motor case. The positive action of the motor is used only to lower the arm. The return of the arm to the danger position is effected by means of a counter-weight connected with the arm in the ordinary way. Fig. 12 shows the compressed air signal motor of the Westinghouse Company. Air is admitted at A, and passes to the valve chamber C, at the upper part of which is the admission valve, S P, which is normally kept closed by a spiral spring. To the armature, B, of the electro-magnet, M, is attached a rod, F, which passes through the electro-magnet, and forms, at its lower end, the exhaust valve. Attached to the lower end of F is a smaller rod, passing down towards the admission valve, and just clear of it when the electro-magnet is not energised. If a current passes through M as the result of the short circuiting of the track magnet, the armature, B, is attracted downwards, and the rod, F, falls, closing the exhaust and opening the admission valves and allows air to pass by the passage, E, to the upper side of the piston, the motion of which lowers the arm of the signal. The electro-magnet, M, is only energised during the time the track relay is short circuited. When that condition no longer exists, the armature, B, is released, the admission valve is closed and the exhaust opened, and the arm returns to the danger position through the action of the counter-weight, which, of course, also returns the piston to the upper part of the cylinder ready for the next operation. The complete arrangement is shown by fig. 13.

(To be continued.)

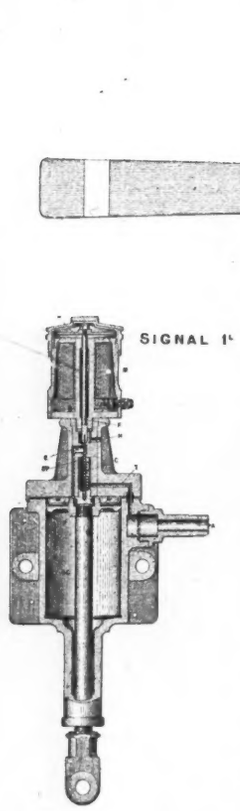


Fig. 12.—Westinghouse Compressed Air Signal Motor.

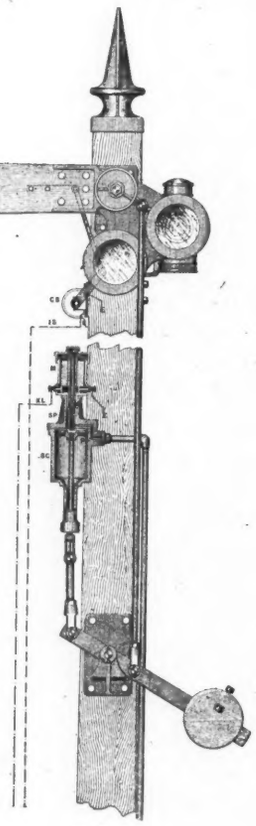


Fig. 13.*

* The positions of the signal arms are shown in accordance with English practice. In America, the running road is on the right looking in the direction in which the train is travelling, and semaphore arms project towards the right.

ELECTRIC CONDUITS.

The June number of *Traction and Transmission* contained three interesting articles on conduits; one anonymous; another by Mr. A. N. Connett, who is the recognised authority on conduit construction; and a third and shorter article by Mr. Ernest D. Phillips, of the Westinghouse Company.

The articles are illustrated profusely, but not unwisely, by clear sections and plans of the various conduits that have met with any success, from the Blackpool pioneer till now, and there are three full-page photos showing the Paris conduit under construction.

The first conduit was designed by Holroyd Smith for Blackpool; and, considering that there was no accumulated experience to help the design, the partial success of this line, which had to work under severe conditions, was gratifying. It was not till 1889, however, that a conduit road proved financially successful. This formed part of the Buda-Pesth system, and was built by Siemens & Halske, being of the side-slot type; that is to say, one of the track rails was formed of a twin girder rail supported directly on the yokes of the conduit.

By this time it was recognised that an expensive system would be rendered very uncertain, and troublesome in operation, if the whole construction peculiar to the conduit was not designed in a substantial manner, and the insulation and drainage most carefully carried out.

The essential points in the design of a conduit system are practically these:—"The slot rails must be so strong, and so well supported and tied, that their relative positions will not be altered appreciably under the most extreme vertical or lateral pressures encountered in practice. The conduit itself must be sufficiently deep to carry away any flush of surface water and mud before it reaches the conductors, and it must be drained sufficiently well to avoid this purpose being defeated. The conductors must be rigid, and attached at frequent intervals to more than usually efficient insulators, which, themselves, must admit of easy inspection and quick replacement, and, above all, must be suspended clear of any possible accumulation in the conduit, or drip from above, as well as leaving the bottom of the conduit clear to facilitate cleaning.

Those who will have the conduit system can choose between three methods. They can have the side-slot throughout, as in Brussels; or the side-slot deflected to the centre at track points, as in Paris; or the centre slot, favoured mostly in America.

Of these three the deflected side-slot seems to be the best, as there is not such a heavily ironclad road surface as with the centre slot, and the inter-connected track and plough points, unavoidable with the undeflected side-slot, are obviated.

There are 270 miles of conduit tramways in the world, so that the experin ental stage, of which so much is heard, may be considered as passed.

A few details of construction on the most important lines may be of interest.

Buda-Pesth.—Yokes 47·25 in. apart. Conduit 13 in. deep × 11 in. wide, in the clear. Overall depth of foundation below rail-top 27·5 in. The comparatively shallow excavation was due to the soil being very firm, thus reducing the depth of concrete foundation.

Metropolitan Railway, N.Y. (1894).—Yokes support rails. T-iron conductors, placed 3 in. each side of centre, and 13 in. below slot, 3 in. deep, weighing 21 lbs. per yard, and supported every 15 ft. Manholes every 30 ft.; handholes midway between manholes.

Ditto, Latest Design.—Excavation required is 30·75 in. × 18 ft. 9 in. Yokes weighing 415 lbs., spaced 5 ft. centres. Every third yoke contains a handhole, and weighs 600 lbs. Conduit 24 in. deep in the clear, with a minimum fall of 2 in. in 100 ft. on the level. Manholes spaced 98 ft. to 125 ft. apart. At points and crossings the whole tracks are carried on masonry piers, to allow access from beneath.

Third Avenue Line, N.Y.—Changed from cable 1899. Yokes carried on I-beams of 70 lbs. per yard. Rails have longitudinal wood sleepers, 6 in. high, interposed between themselves and the yokes.

Brussels.—Side-slot, I-section conductors, 25 ft. long. Yokes on 6 in. of concrete, 4 ft. between centres. Width of slot stated as 1·18 in., frequently 2½ in. or more at points and crossings. Independent yokes. Insulators easily removable from roadway. Manholes and sumps every 130 ft., connected to drains.

Berlin.—Similar to Buda-Pesth. Yokes 49·2 in. apart. Conduit 13½ in. wide × 17¾ in. deep.

Paris.—Side slot, deflected to centre at points and crossings, to avoid difficulties experienced at Berlin and elsewhere. Slot rails supported on yokes spaced 3 ft. 5 in. apart, and tied to them. Inner rails of double track tied together every 7 ft. Conduit 26 in. deep × 15 in. wide in clear. T-iron conductors suspended from insulators spaced 13 ft. 8 in. apart.

L.C.C. Tramways.—To have slot rails 50 lbs. per yard; width of slot ¾ in. Conductors of T-iron 23 lbs. to the yard, supported on pedestal insulators every 15 ft. Yokes independent, and spaced 5 ft. apart. Conduit, 25½ in. deep over all (from surface of road), resting on 4 in. of concrete. Slot rails tied to track rails, and further held apart by wooden wedges between yoke and slot rail. Four in. clearance between conductor rails and bottom of conduit.

Mr. Connett points out that the heavy yokes extended to carry the track rails are useful chiefly to keep the relative alignments perfect, and become unnecessary when the rails are laid on solid concrete in the prevailing English manner. It is open to question if 4 in. of concrete can be called solid enough for the very heavy traffic in the London streets.

If the slot rails are supported on unextended yokes in each case, the cost of the side slot and of the centre slot should not be very different. Apart from cost, the deflecting side slot is the more satisfactory of the two, as the amount of iron in the street is diminished considerably.

From the cyclists and carriage owners' point of view, the side-slot is preferable, as there is one less slot per track to avoid, although the Brussels slot, which is stated to widen to 2½ in. or more at points and crossings, is not a thing one would care to ride over on 1½-in. tyres. This, however, is the undeflected slot.

Mr. Connett extracts from a letter written by him at the end of 1896, dealing with the Washington conduits, some interesting statements. During the 17 months the Ninth Street line had then been running, only three serious delays had occurred, one of which was due to an intruding cable-car. There were a few small delays owing to short-circuited ploughs, or conductor rails, and these were cleared by burning out. The station is equipped with a special burning-out panel, a regulatable resistance being put in series with the fault. 300 amperes applied from one to three minutes will settle the hash of the worst short, and would, we should imagine, cause occasional pyrotechnics in the streets.

In dry weather the leakage across conductor rails was ·037 ampere per mile of track, rising to ·19 ampere in very wet weather. This is good, but it is curious to note the attitude of the writer with regard to leakage. His incentive to its reduction is economy: ours is the fear of the Board of Trade.

In the letter he states that the operating expenses compare favourably with any American line, but his later experience has taught him that it costs more to operate a conduit than an overhead line.

His objections to the conduit are :—"(1) The cost of installation. (2) Dependence upon the municipality for a fairly effective system of sewers. (3) The change from trolley to plough, or *vice versâ*, to allow through cars to run over both. (4) Increased cost of maintenance and renewals of special track work due to the slot frogs and switches. (5) Greater care and attention necessary in the maintenance of the plough than of the trolley."

But he adds :—"Despite these objections, the open-slot conduit is, in my judgment, by far the best and most economical method of operating a metropolitan street railway in the present stage of electrical development, *when overhead rights cannot be secured.*" (Our italics.)

To show how desirable it is that overhead rights be secured, it will be well to make a comparison of the cost of the conduit with the cost of the trolley. For this purpose we have borrowed figures from Mr. Connett's paper, read before the Institution of Mechanical Engineers on March 15th, 1901, and from Mr. E. Manville's report to the Leicester Corporation presented this year.

Mr. Connett's Paper.—Local circumstances govern cost to a very large extent. The side slot can be built for £500 per mile less than the centre slot, so long as it is side slot throughout, and not deflected to the centre at junctions, turn-outs, &c. In that case, the cost is rather heavier than for the centre slot.

It is quite impossible to say at sight what expenditure will be required for the removal and re-instalment of pipes, sewers, cables, and the infinity of obstructions which may be encountered. This cost can be reduced by the use of a specially shallow conduit in such cases; but, on another occasion, Mr. Connett remarked:—"I would recommend a 20-in. tube for cases where many abnormally shallow subsurface constructions were to be encountered. If these were few, I should prefer the 25-in. tube, *because the increase of cost is so trifling, while the factor of safety for the accumulations of dirt and water is increased.*" (Our italics.)

Under ordinary conditions conduit construction will cost between £7,000 and £9,000 per mile more than the overhead trolley construction. Mr. Connett appended a detailed estimate for a mile of single-track conduit under average English conditions. The total came to £16,500.

Mr. E. Manville estimates the cost of constructing 9 miles of single, and 19½ miles of double-track conduit, exclusive of feeders, and including 10 per cent. for engineering and contingencies, at £598,861. To this was added the considerable sum of £54,064, as the amount estimated by the borough and water engineers to cover alterations to existing subsoil obstructions, thereby swelling the total to £644,925, or £13,500 (nearly) per mile of single track.

On the other hand, the estimate for construction of the same mileage on the overhead system, on the same basis, was £299,306 total, or £6,250 (nearly) per mile, showing a difference in favour of the latter system of £7,250.

In other words, it is possible, on this estimate, to construct rather more than twice the mileage of overhead trolley for the money required by the conduit.

The item of something over £1,000 per single-track mile for removing subsoil obstructions will rise, without a shadow of doubt, to a very much more formidable sum when the London streets are tackled. In fact, we shall not be surprised to learn that the money spent in this way alone would have sufficed to construct, on the overhead system, half the mileage required. In the first of the three articles under notice, the average cost per mile of single-track conduit in New York City is given as £30,000, "as compared to a maximum of £8,000 per mile of single track for the most elaborate system with overhead construction."

Are all the objections set forth by Mr. Connett outweighed by the better appearance of the conduit as compared with the trolley? It seems more than probable that the hitherto unaroused ratepayers of the metropolis, when called upon to slacken their purse strings a little more, and ever a little more, will damn the æstheticism and not the expense.

The anonymous first article is of considerable interest at the present time, for the author, after tracing the evolution of the modern conduit, proceeds to add his voice to the general chorus of condemnation of the L.C.C.'s plaything.

After five years' gestation, this progressive body has brought forth an atavism. In the drawings which have been made public are to be seen most of the failings which have

been eliminated from all the existing conduits. Weak slot construction—three times, and more than three times weaker than any modern slot; insulators that cannot insulate, and which will prevent the proper cleansing of the conduit; totally inadequate clearance between the conductors and the bottom of the yokes, even when the depth of the yoke in the conduit would allow this distance to be increased sufficiently; these are three maladies, of which one alone would be enough to kill an otherwise healthy system.

Mr. Phillips ends his article with a hope that has proved forlorn:—"It is to be hoped that the system adopted on the experimental lines will adhere so closely to recognised practice, that failure, even in its most modified form, will be impossible."

If Londoners are unable to veto the carrying out of an "experiment" with their money, obtained by forced loan, they should at least refuse to allow that experiment to be conducted from the egg, when healthy birds are strutting almost-at their doors.

THE NATIONAL INDUSTRIAL ASSOCIATION.

"The greatest effort that has ever been made to improve the trading conditions of this country." Such is the opinion of the *Engineering Times* on the effort now being made by Mr. John Lockie, to build up the Association bearing the above title. It is "a great and patriotic endeavour to create and cement a feeling of common interest between employer and employé."

Mr. Lockie is a Newcastle shipowner and broker, who has, by years of close application to commercial matters, made for himself a prominent position in the shipping trade in the North of England, coupled with considerable wealth. He is now applying a portion of his money and leisure to the formation and building up of a National Federation of Employers' Associations and Trades Unions having the following aims:—

Aims.

1. To bring about an association of societies interested in trade questions, as employers, employed, or as merchants.
2. To keep before the minds of the employers and employed, that the practical recognition of their common interest will strengthen and promote British trade and commerce.
3. To inquire into and report on matters affecting British trade and commerce, with a view to enable our manufacturers to hold their own in the markets of the world.
4. To create and cement between employers and employés a feeling of common interest.
5. To provide an association where employers and employés can meet on all occasions on the same plane.
6. To create permanent machinery for conciliation which will be available in case of any threatened dispute between employers and their men.

Mr. Lockie has already spent many thousands of pounds on the work, and will continue to pay all expenses in connection with the Association until it becomes self-supporting.

With the spirit animating the founder, every thinking man will, no doubt, be in agreement, and will wish the Association success in its endeavour to bring about such an understanding between employer and employé as shall ensure a lasting industrial peace. A very large number of employers of labour have signified their approval of the scheme, as have also many labour organisations.

This in itself is a promising sign. There may be, and no doubt will be, differences of opinion as to the relative value to be attached to the several aims of the Association. Whilst Mr. Lockie emphasises the second, namely, that which insists upon the common interest of, and joint responsibility resting upon, employers and employed with respect to the expansion of British trade and commerce, others, who consider that the British manufacturer—particularly in the electrical engineering line—is not sufficiently alive to the reality of foreign competition, will attach greatest importance to the third, whilst many will consider that the sixth aim, which has for its object the creation of permanent machinery for conciliation and arbitration, outweighs in importance all the others.

The industrial problem to-day is not quite the same as it was, say, 100 years ago. Owing to the introduction of labour-saving machinery the relative positions of the working man and his employer have undergone very considerable changes, and the divisions of labour have gradually increased in number and become more and more specialised.

This is one of the features of modern life which has called into existence a class of agitators who would like to reorganise our present social system and start again on an equal footing. Such equality would, of course, be very short-lived, and whilst our large works contain many followers of this absurd and impossible doctrine, the more thoughtful artisan has transferred his allegiance to those reformers whose battle cry is, "Equality of opportunity."

This is a very attractive phrase, but until we get equality of brain power there will be no such thing as equality of opportunity, as a far-seeing man will see opportunities where a short-sighted though equally well-educated man would not.

It is just this that makes one man work more than another. But how much more? Our trades unions appear to work upon the lines that all men are equal when doing the same class of work, and should all receive the same wages. Some would-be social reformers claim that no man, however gifted, could by his own ability honestly earn more than 30 times as much as the highest-paid artisan. No employer of labour, therefore, on this assumption would have any right to pay himself more than 30 times the wages of the highest paid workman.

This may appear to be wandering from the aims of the Association under consideration, but it is really leading up to the fourth aim, which is "to create and cement between employers and employés a feeling of common interest."

Now, in this sentence, it is recognised that at present there is *no* ground of common interest between master and man, whereas in the second aim it is assumed that there *is* a common interest, which, if recognised, "will strengthen and promote British trade and commerce."

The *Engineering Times*, in commenting upon the second aim, says:—"It is absolutely necessary, in the face of the present keen foreign competition, that the people of this country should recognise that their interests are the same, whether they be employers or employés;" and again, "we are convinced that *if masters and men can be educated to the idea that their interests are identical, strikes and lock-outs will be things of the past.*"

It is here assumed that the common interest lies in opposing the common danger of foreign competition.

Without entering into the question as to whether or not foreign competition is the danger it is made out by some alarmists to be, or whether, on the other hand, it may not really be a healthy and helpful competition, providing a wholesome stimulus to our home manufacturers, it may be pertinent to ask whether or not the British workman takes the slightest interest either in foreign competition or in the expansion of British trade and commerce. It is safe to say that, as a rule, he does not trouble his head about such things. His interest is to secure the highest wages and the shortest hours he possibly can. The masters' interest, on the other hand, is to sell his goods for the best price he can get and to produce them as cheaply as possible.

If he cannot get cheap labour, he will introduce labour-saving machinery, either to increase his output or to reduce the number of men he employs. It is argued by employers that labour-saving machinery does not decrease the demand for skilled labour, but increases it, and that it is a higher type of labour to make a machine that will replace a man, than to merely perform work that a machine can do quite as well. Very true, but what of the man whose place is taken by the machine? He does not immediately find fresh employment in a labour-saving tool manufactory. He must either get work elsewhere in his own trade, or in some other and less skilled occupation. It may work out all right in the end from the general point of view, but from the individual workman's point of view it is all wrong.

There is no community of interest here between employer and employed; the only interest they have in common is *self interest*.

In connection with the recent Trades Union Congress at Swansea, Mr. Lockie addressed a meeting held in support of the Association he has founded, when a resolution was adopted to this effect: "That this gathering of members of the Trades Union Congress believes that common ground of interest and of agreement betwixt producers is possible, and that there should be a general agreement, with conciliation and arbitration as a principle, and as a means of preventing and settling industrial disputes." The principle underlying the proposed "National Industrial Association" was also approved, and the affiliated societies recommended to give the scheme their careful consideration.

It will be noted that these trade unionists "believe that common ground of interest is possible." This is quite a different thing from saying that a common interest exists between employer and employed.

Under the usual trades union conditions of labour, the interests of master and man are practically those of buyer and seller; the one wants the most for his money, the other gets as much as he can for as little as possible. There is no common interest between a buyer and seller, except when the transaction is carried out on co-operative principles.

This apparently is what Mr. Lockie has in view, for he writes to the *Imperial Argus* for September: "To my mind, the first thing we have to do is to get the employers and the employés into a closer relationship, and this having been achieved and more mutual confidence thus arising between them, the co-partnership question could be much more easily settled.

"The payment by the results is, on the face of it, the ideal mode of remuneration to be given to anyone, but the question is so great that until, as I have said, an absolute feeling of confidence prevails, which would form the basis of a satisfactory and lasting arrangement, I fear that the majority of employers would not be prepared to fall in with the co-partnership idea."

Here, then, we appear to have the germ idea underlying the formation of the Association, and upon this idea there is certainly a very great divergence of opinion. Mr. Barnes, the general secretary of the Amalgamated Society of Engineers, says "co-partnership is but a variant of the profit-sharing idea, dressed up in the alluring garb of co-operation." Whether or not the garb is alluring, it must be admitted that the terms "co-partnership" and "profit-sharing" are practically synonymous.

There are probably very few large employers of labour who have not at some time or other given some thought to the idea of profit-sharing.

In the minds of many people the idea suggests philanthropy or charity, but it is neither; it is a method of conducting business. In some cases a portion of the profits has been set aside to provide comforts, amusements, or recreations for the employés. The towns of Saltaire, Port Sunlight, and Bournville are cases in point, and whilst in the popular mind Sir Titus Salt, the Lever Brothers, and the Cadburys may rank as philanthropists, they would be the first

to admit they were business men first, and that the apparent philanthropy was an excellent plan for conducting business profitably.

British manufacturers are rather suspicious that in the long run profit-sharing does not pay. It is all very well to point to the exceptional experience of the Maison Leclaire, extending over half a century; they reply by pointing to the failures of Messrs. Briggs, at Whitwood Colliery, and Messrs. Fox, Head & Co., at their iron-works in Middlesbrough. In the former case the scheme was abandoned after a trial of over seven years on account of the dissatisfaction of the outside shareholders, because during the years of inflated prices the miners received an undue proportion of profits, profits which were in no way due to their own industry.

In the case of Fox, Head & Co., the failure was largely due to their hostility to the trades unions.

Now, whilst profit-sharing may pay very well in some trades, say, paperhanging and painting (*e.g.*, Maison Leclaire), where the cost of labour forms a very considerable proportion of the total cost, it by no means follows that it would pay in electrical engineering works, where the cost of raw material is very high in comparison with the labour item, where so much depends upon management and works organisation, and where the labour can be reduced to a minimum by means of labour-saving tools. In electric wiring work, where such tools have practically no scope, the conditions are more analogous to the work carried on by the Maison Leclaire, and any wiring contractor of experience will know that it is the labour item that determines the question of profit or loss. Before the Electrical Workers Trades Union started, it was possible to get a good wireman to take on a wiring contract for a fixed price per light for the labour, upon condition that he was not to lose by the transaction if the work cost more than the stipulated price. This, however, is risky, as it is not possible to examine wiring when finished, or even during progress, as is possible with painting and paperhanging. However, the trades unions do not now permit such profit-sharing or piecework.

It takes at least two parties to make a bargain, so no matter how willing masters may be to give the system a trial, the trades unions have first to be reckoned with.

The latter are not agreed among themselves on the subject, and whilst many unions and societies have expressed their approval of the aims of the Association, the names of the most influential unions, such as the Amalgamated Society of Engineers and the Amalgamated Society of Railway Servants, do not figure in the list.

We have already quoted from the *Railway Review*, the organ of the Amalgamated Society of Railway Servants. A perusal of the article quoted from convinces us not only that the writer is hostile to the principle of co-operation or profit-sharing, but that he labours under a misconception of what it really means when he says, "Without a fixed standard of wages, profit-sharing is a delusion and a snare." Of course, no system would be acceptable to the employé which did not guarantee to him a fixed minimum wage.

Mr. G. N. Barnes, whose claims as a labour leader rest largely upon the disastrous strikes he has engineered, contributes to the *Imperial Argus* a long criticism upon the subject. "The whole idea of profit," he thinks, "is based upon exploitation." The "exploitation of labour" is one of the stock phrases of the socialist trades unionist. He says, "What is needed is union of workmen, a higher sense of civic duty among all classes, and the building up of a co-operative movement at once self-sustained, homogeneous and humane. Out of this may come not profit-sharing, but the elimination of profits and the conducting of industry in the interests of the industrious."

To paraphrase one of his earlier sentences, this appears to be but a variant of the "by the people, for the people" idea. Well, is this not collective ownership, the Trades Unionist Congress doctrine? What, then, does Mr. Barnes mean by this peroration, "I think they should render a fair day's work for a fair day's wage, leaving workshop management to workshop managers, and profits to those who want them." Surely, even in collective ownership, some workshop management will be required, and without profits there would be no "fair day's wage" to draw.

Sufficient has now been said to show that, at present, any ground of common interest there may be is not founded upon a very solid basis, and that the Association has before it years of hard work in which to "create and cement" such a foundation.

If the Association can even "create and cement a feeling of common interest" between the various trades unions of workmen, it will achieve something that will tend to promote a better feeling between them and the employers' federations. Electrical engineering employs members of probably more trades unions than does any other trade. To name only a few of them, there are moulders smiths, engine fitters, brass workers, tool makers, cabinet makers, joiners, plumbers, electrical workers, and labourers. A strike among any one section might disorganise a works. There is between the various trades as much class hatred as there is between any of them and the masters. Each union, in fact, seems to attempt, not only to secure for its members the best terms possible, and the best conditions of labour, but it seeks also to secure to its members a monopoly of a particular kind of labour, to create, in effect, a "corner" in labour. In a strong trades union centre it may often be necessary to employ three or four men to do what one man could quite easily do alone. In ship lighting work, say, on the Tyne or Wear, this is particularly noticeable, though in prosperous years, as at present, the "delegates" are not so keen. Fitters have been forbidden by hand drillers to drill holes in iron bulkheads; hand drillers in turn not allowed to cut holes above a certain diameter, as this was boilermakers' work; joiners debarred by carpenters from cutting holes through deck planks; and wiremen in turn prevented by joiners from fixing the wood blocks for switches and fittings, and not allowed by engineers to tend the plant during a trial run.

Whilst, therefore, we heartily wish success to The National Industrial Association in its endeavour "to create and cement a feeling of common interest between employer and employé," we think it important to remember that, at present, there is no such community of interests; that, on the other hand, there is considerable divergence of interests. One of the first objects, therefore, should be to recognise the extent of this divergence. In the days of craft guilds, before the advantages of gathering many workers under one roof had any existence, the relation between master and servant was almost that of father and son. They were brought into intimate and frequent contact. The identity of interest was recognised, good work was done, the employer insured his workers and their families against want. But conditions changed. The guilds tried to regulate industry and impose restrictions and create monopolies. The trade was driven from the towns to places where it could grow in freedom. History repeats itself. The trades unions, which started as benefit societies, now seek to create monopolies in and to restrict labour, and to raise prices above a profitable limit. They, too, have driven industry to other countries where it can develop freely.

Let us recognise the danger; let both masters' federations and workmen's unions recognise the nature and extent of their divergence of interests; let them also recognise the power of each other as a fighting force, and, before fighting, ascertain accurately what they are going to fight about, and if it be worth the while.

It is better policy to recognise the *divergence* of interests than to patch up a peace under a mistaken notion of *identity* of interests.

Under present conditions there is no more community of interests between employer and employé than there is between Boer and Briton, and unless the divergence is fully recognised, it must be a fight to the bitter end.

CORRESPONDENCE.

Electric Traction Battery Tests.

In your issue for September 13th Mr. Rankin Kennedy makes sweeping assertions under the above heading, on what seems to him inability on the part of the *Automotor Journal* and autocar people to discriminate between battery tests and car tests. There is nothing in Mr. Kennedy's letter justifying this opinion on his part, and there is also nothing that would lead the reader to regard Mr. Kennedy's opinion on traction batteries or vehicles as valuable. The "Powerful" is a first-class electric touring car, but it is not a vehicle that has been designed to run on a prepared track with the minimum of energy so as to make a sensational record run. The average consumption of energy of the "Powerful" is, I believe, 127 watt-hours per mile ton, and the bearings throughout are neither roller, nor ball bearings, but plain. On the long-distance runs recorded with "Leitner" battery, the energy the battery had to furnish amounted to at least 25,000 watt-hours. In its tour of several thousand miles, the normal discharge rate of 35 amperes was constantly exceeded, and as much as 90 and 120 amperes were drawn from the battery for periods of 1 to 1½ hours.

Other batteries have been tried in the "Powerful" as far as I know, and the fact that "Leitner" accumulators are now used exclusively in the vehicles of the British and Foreign Electrical Vehicle Company, Limited, proves that they are the most satisfactory.

As regards Mr. Kennedy's insinuation that "comparisons are odious," none are made. A "Leitner" cell was tested by an outside expert against what he considered the best cell in the English market, and the watt-hour capacity of the former proved to be four times the capacity of the latter, and whereas enormous discharges did not appreciably injure the "Leitner" cell, the Standard English cell lost 50 per cent. capacity and showed signs of breaking up.

Mr. Kennedy's suggestion that cells of different makes (and therefore different weights, capacities and discharge rates), should be coupled in series, and put to driving a vehicle, is on a par with coupling steam engines of various strokes and speeds together, and then testing steam consumption. The suggestion is so utterly ridiculous that it hardly merits criticism. To begin with, the vehicle could be run in a manner harmonising with the best discharge rate of *any* set of cells, and furthermore, the lightest cell would have to do *much more work*, and the heaviest cell *much less work* in propelling the vehicle, than if the battery consisted entirely of light cells or heavy cells respectively; in short, the results obtained would have no value or practical application whatsoever.

Henry Leitner.

Woking, *September 25th*, 1901.

Coal Consumption in Power Stations.

The interesting correspondence which has appeared in the columns of the Review for the 13th and 20th inst. respectively, relating to the consumption of coal in generating stations, has led me to offer one or two suggestions. As Mr. Langdon's figures have started the topic, allow me to refer back to the discussion on his paper, read on November 29th, 1900, on p. 171, Vol. xxx., of the *Journal of the Institution of Electrical Engineers;* it will be found that Mr. Walton suggested "that if we could . . . . speak of the cost of coal, and not of the weight of the coal, it would be much better. We are all burning different kinds of coal, and no one gives the calorific value; one is burning Welsh coal and another is burning practically dirt."

Might I therefore suggest that such correspondents as are in a position to impart the information, should, in giving the pounds of coal consumed per unit, also state both the calorific value and cost per delivered ton thereof. It may be readily conceived that with varying prices of coal, the engineer who can produce one B.O.T. unit for 5 lbs. is obtaining energy at a lower cost than he who obtains the same output for only 4 lbs. of coal, and it is the reduction of cost with which power station engineers are chiefly concerned.

If, therefore, contributors on this subject would state (1) the calorific and money value of their fuel; (2) the size and type of generating units employed; (3) the type of boilers, whether water-tube, tubular, or flue; (4) the pressure and condition of the steam, whether saturated or superheated, and if the latter, the degree of superheat at the stop valve; and (5) whether or no the coal consumed covers that required for generation of steam for necessary auxiliary purposes, those interested in the subject would be able to form a better opinion of published results.

Even "W. H. J.'s" higher figure—2·36 lbs. of coal per unit, is truly astonishing. Referring to *Lightning* for September 12th, 1891, it will be found that the cost of fuel per unit in Leeds Corporation electricity works was 0·31d. with a load factor of only 10·34; if this coal cost 10s. per ton delivered, the coal consumption was 5·78 lbs. per KW.-hour, and Leeds is recognised to possess one of the most economical stations in the country.

If "W. H. J." would therefore be kind enough to give information based on the above suggestions, I am sure that all your readers would be much indebted to him for a most interesting statement.

C. E. D.

Manchester, *September 25th*, 1901.

Electric Railway Traffic.—A Forecast.

A practical experience of the difficulty of getting from one wayside station on a main line of railway to another has suggested the following thoughts, which are perhaps more particularly applicable to conditions of electric traction that have not as yet been developed.

Is not too much prominence given to record runs and the shortening of the time between one terminus and another? For the whole-distance passengers this may be an excellent arrangement, but it means that the line is of little benefit to the greater part of the country through which it passes, the dwellers therein having no opportunity of boarding the express trains that dash past them. Suppose that, instead of running trains for 200 miles without a stop, we were to call a halt about every 40 miles; this would not prolong the journey unduly, and it would give people living along the line a chance of joining the express. No part of the line could then be more than 20 miles from an express stopping station, and to render the arrangement complete, we should run slow trains (or electric trams) in both directions to meet the expresses, and also see that, whenever an express reached a stopping place, there should be such a train or tram ready to start off in each direction, and carry passengers a few stations backward or forward as they might require. In this way the utility of an express train would be immensely increased, without impairing its efficiency as a means of traversing long distances.

Even then, however, an express train would not be available for use by a traveller wishing to proceed from a station half way between two of the stopping places to the next similarly situated station, but he would be obliged to traverse the 40 miles entirely by a slow train or tram. To remedy this we might arrange *two* sets of express-stopping stations, A and B, thus:—

A A A
B B B

Some expresses being appointed to call at all the "A" stations, and *others* to call at all the "B" stations instead. In this way no point of the line would be more than 10 miles from an express-stopping station, and yet no express would be stopped more frequently than before. We should distribute our favours, in fact, between double the number of stations, to the great advantage of residents on the line.

The design, in short, is to combine absolutely express traffic (with stoppages every 50 minutes or so) with a liberal local service all along the line, and so develop a traffic, not only from one terminus to another, but from any wayside station to any other, however distant.

This, it seems to me, is the true function of a railway, and not merely to transport a Londoner from his overgrown city to a seaside resort on the other side of England; and this, there is little doubt, could be more easily carried out on an electrical railway than on one worked, as now, by steam locomotives.

Alfred J. Allen.

London Institution,
Finsbury Circus, E.C.
September 28th.

Cardiff Corporation Electricity Accounts.

I have read with interest your criticism on the Cardiff Corporation electricity accounts, but, in referring to the past year's working as the first in which a surplus has been made, permit me to point out that it has escaped your notice that a surplus of £60 was made in the third year's working, the deficits on the first and second years being £2,023 and £1,200 respectively. With a £60 surplus the committee insisted on a reduction of practically 20 per cent., contrary to my advice for a reduction of about one-half that amount, as may be seen by the local press reports of that date.

The reduction of the wages bill is due to the use of the modern generating units put to work during the last two years.

Neville Appelbee.

Ashton-under-Lyne, *September 30th*, 1901.

The L.C.C. Tramway Engine and Generator Contracts.

I was very pleased to notice your comments in last week's issue on the above.

The conditions which the London County Council impose in this particular instance are delightfully inconsistent. On the one hand they seek to conciliate the trades union by the insertion of the wages clause, while, on the other hand, they put the possibility of an English manufacturer securing the order out of the question, and so practically send abroad work which could be perfectly well carried out in this country. It is impossible to conceive that any similar foreign body would act, or, for that matter, would be allowed to act, in this way.

A certain section of the press is continually devoting its voice to the adulation of foreign manufacturers and their methods, while it might, with more perceptible results, devote its energies to the exposure of injustices to home manufacturers such as the London County Council by the imposition of such conditions inflict. There is absolutely no necessity for the work being sent out of the country in this case, and an expression of opinion by English manufacturers as to their own incompetence to build the plant required by the London County Council, would, I fancy, form interesting and, for the L.C.C., instructive, reading.

It would also be interesting to know why the advisers of the L.C.C. seek to limit the number of tenderers. It surely cannot be due to want of reliance on their own capabilities, as the construction of three-phase plant is, in no essential respect, different from single-phase or two-phase.

Regarded from the point of view of inconsistency, the whole business is simply artistic.

G. E.

REVIEWS.

The Engineer or Architect as Arbitrator between the Employer and the Contractor, and his other Functions under Building Contracts. By Charles Currie Gregory, A.M.I.C.E.; member of the Canadian Society of Civil Engineers; barrister-at-law, of Osgoode Hall; also of the bar of Nova Scotia. Demy 8vo., cloth, 12s. 6d. London: Wm. Clowes & Sons.

All who have read the above work will admit that it is one of which the engineer and architect have long felt the want. Text-books there are which touch upon the legal relationship of these gentlemen to those who employ them, but we know of none which sets forth the legal duties of members of these two professions with greater thoroughness than the volume which is now before us.

Had the book been written by a mere lawyer, it might possibly have escaped the attention of the "laity;" but Mr. Gregory, as his qualifications testify, is able to combine a knowledge of English and Colonial law with the experience of an engineer. One naturally expects, therefore, that everything which comes from his pen is worthy of attention, and a study of the work will gratify that expectation.

The book contains eight chapters. Of these the first explains the position in which the engineer or architect stands towards the parties to an engineering or building contract. A glance at the few pages which are devoted to this question show how difficult is the position of an engineer. He is at one time agent for his employer, and at another time may find himself called upon to act as arbitrator between the parties. Chapter II. is devoted to a general view of the functions of the engineer or architect under building contracts. It practically introduces the remaining chapters to the reader. The duties of the engineer or architect are thus classified:—(1) Definition of the work required to be performed; (2) approval of work after it has been performed; (3) enforcement of diligence on the part of the contractor, and the duty of affording to the employer the means of avoiding injury through a delay in the completion of the work; (4) the duty of ascertaining and certifying the amounts which from time to time become payable to a contractor; (5) the duties of an engineer as arbitrator. All the chapters devoted to the above subjects should be read with care by engineers and architects who are anxious to perform their many duties conscientiously. Mr. Gregory's pages are an eloquent, if unconscious, plea for the contractor, who is so often heard to ask for an independent tribunal to determine the differences which arise between him and the building owner. In the majority of contracts for the execution of public works and other large undertakings, the opinion of the borough engineer or surveyor is declared by a clause in the agreement to be final and binding between the parties. The contractor cannot help himself; he is forced by competition to submit to a clause of this kind. We have often complained of the unfairness of this system*; the labours of Mr. Gregory may tend to mitigate the evil by subjecting it to the scrutiny of public criticism. We need hardly say, however, that the author has confined himself to expounding the law as it is, and has not wasted time in declaring what it should be.

There is one branch of his subject to which Mr. Gregory might, perhaps, have devoted a little more attention. We refer to the responsibility of an engineer or architect for negligence. Thus there is no heading for "Negligence" in the index, and, upon looking through the volume, we have not been able to find that the subject has been dealt with at any length. It must be admitted, however, that few cases which might have thrown light upon the question have been brought before the Courts. This is, perhaps, due to the fact that the architect (as Mr. Gregory has so often and so clearly pointed out) is frequently neither more nor less than the servant of the building owner employed to define the quantities upon which shall depend each payment to the builder. Since the publication of the work under review, two interesting cases have come before the Courts. We refer to Chambers-Goldthorpe and Restell *v.* Nye (Court of Appeal, 17 T. L. R., 304). In those cases the facts were that, by a building contract, the certificate of the architect employed by the building owner, showing the final balance due or payable to the contractor, was to be conclusive evidence of the works having been duly completed, and that the contractor was to receive payment of the final balance. In an action brought by the building owner against the architect for negligence, it was held by the Court of Appeal (Lord Justice Romer dissenting) that the architect, in giving his final certificate, was placed in the position of an arbitrator as between the building owner and the contractor, and was not liable for negligence. This important judgment was delivered on February 27th, 1901, and was probably too late for inclusion in Mr. Gregory's valuable work.

Mr. Gregory has pointed out the circumstances in which a proposed engineer or architect must be deemed to have such an interest in the subject-matter of the contract that his judgment will necessarily be biassed.

Here, again, a case of importance has been discussed in the Courts quite recently. In the Haslam Foundry and Engineering Company *v.* Smithfield Markets* the plaintiffs agreed to supply the defendants with certain refrigerating machinery. A dispute having arisen in relation to the quality and efficiency of the machinery supplied, the matter was referred to arbitration, in accordance with the arbitration clause. The Court nominated an engineer of high standing to act. He gave his award in favour of the defendants. The plaintiffs then appealed to the Divisional Court to set aside the award on the ground that when he made his award the arbitrator was a shareholder in a company which was a trade rival of the plaintiffs'. It was alleged that this was of considerable importance, inasmuch as there were only a few firms which manufactured refrigerating machinery. It was proved, on the other hand, that the arbitrator's holding of shares was not a very large one, and that even if he had remembered it, it would not have occurred to him to mention the fact that he was a shareholder, as he stated that this would not have influenced his judgment. In the event, the Divisional Court refused to set the award aside.

With regard to the literary style of the work, we would only point out that it errs upon the side of discursiveness. A little more sub-division, more frequent headnotes, and a slight curtailment of the length of the sentences would render it more easy to understand. The table of cases and the index must tend to a large extent to obviate these disadvantages of the work to a lawyer, but as the work is designed for the engineer and the architect, greater facilities for reference would have been desirable.

We should be sorry, however, if slight disapproval of details should lessen our appreciation of a treatise which will form a useful addition to the library of every engineer, architect and lawyer.

* See Electrical Review, July 19th, 1901, p. 96.

BUSINESS NOTES.

London Electrical Contractors' Association.—The first general meeting of the above association was held at Anderton's Hotel, Fleet Street, E.C., on Thursday, September 26th, the president, Mr. W. R. Woodward, being in the chair. The following were amongst the firms represented:—Messrs. Rawlings Bros., Peto & Radford, E. P. Allam & Co., F. A. Glover & Co., C. H. Cathcart, Buchanan & Curwen, Simmonds Bros., V. G. Middleton, the Lighting Corporation, Donnison, Berlyn & Sillem, Gillard and Co., Troup & Curtis, &c. A number of letters were read expressing sympathy with the movement and regretting inability to attend. The question of trade discounts being allowed to private consumers by wholesale houses was exhaustively discussed, and a number of suggestions were put forward which were of interest and value to the electrical trade in general. As a result of the meeting the membership of the association has greatly increased. Contractors who have not yet joined can obtain particulars from the secretary, at 567, Battersea Park Road, S.W.

Spain Orders in America.—Laffan quotes the *New York World* to the effect that Spanish firms are giving large contracts to Americans for machinery and railway materials. These include 1,000 cars for standard railways and six locomotives for mining railroads. There are also orders at hand for tools, lathes, and electric and pneumatic machinery for the Trubia Arsenal.

* Noted *Engineering*, August 2nd, 1901, p. 155.

Electrical Wares Exported.

Week ending Oct. 2nd, 1900.		Week ending Oct. 1st, 1901.	
Alexandria	Value £140	Amsterdam	Value £140
Amsterdam	30	Barcelona	1,571
Auckland	90	Bombay	46
Buenos Ayres	95	Bordeaux	13
,, Teleg. mat. ..	842	Boulogne	48
,, Teleph. cable..	125	Brisbane	16
Calcutta	248	Calcutta	529
Cape Town	211	Cape Town	221
Cochin	21	,, Teleg. mat.	371
Copenhagen. Teleg. wire ..	247	Christchurch	41
Durban	250	Christiania. Teleg. wire ..	37
,, Teleg. plant	147	Colombo	50
,, Teleph. mat.	170	Copenhagen. Teleg. wire ..	145
Fremantle	164	Demerara	90
Gibraltar	196	,, Elec. motors.. ..	100
Hamburg. Teleg. mat... ..	400	Durban	261
,, Teleph. appar. ..	406	East London	522
Hong Kong	76	Fremantle	458
Launceston. Elec. motors ..	231	Hong Kong..	479
Lisbon	50	Kobe. Teleg. cable	65
Lyttleton	300	Korsor. Teleg. cable	4,950
Melbourne	206	Lisbon. Elec. launch	450
Monte Video	46	Malta. Teleg. cable	74
Ostend	20	,, Teleg. mat.	400
Otago..	56	Melbourne	100
Port Chalmers	38	,, Teleg. wire ..	224
Port Elizabeth	22	Nagasaki. Teleg. mat.	6,500
,, Teleg. mat. ..	473	Ostend	70
Port Said	8	Penang. Teleg. mat.	253
Rio Janeiro..	142	Perth	86
Rosario. Teleph. mat.	219	Port Elizabeth	33
Rotterdam	16	Rotterdam. Teleg. mat. ..	91
St. Petersburg. Teleg. paper ..	70	Shanghai	75
Singapore	54	Singapore	139
,, Sub. teleg. cable ..	50,000	,, Teleg. mat.	389
Stockholm. Teleg. wire ..	260	Stockholm. Teleg. wire ..	84
Sydney	336	Sydney	1,987
,, Teleg. mat.	120	Wellington. Teleg. mat. ..	309
,, Teleph. cable	695	Yokohama	385
Valparaiso	80		
,, Teleg. wire	344		
,, Telephone	70		
Vera Cruz. Teleg. mat. ..	73		
Wellington. Teleg. mat. ..	492		
,, Teleph. mat. ..	68		
Yokohama. Teleg. cable ..	12,395		
,, Teleg. wire ..	655		
Total ..	£71,667	Total ..	£21,802

Bankruptcy Proceedings.—First meeting, October 4th; public examination, October 10th, at Newcastle, in the case of J. A. M. Collier, electrical engineer, of Gateshead.

Dissolution.—Messrs. F. & A. H. Hodgson (F. Hodgson and Co., electrical engineers, 11, Poultry Chambers, E.C., Kensington, Blackheath, &c.), have dissolved partnership.

Books Received.—"The Use and Working of the Watch Calculator and the Slide Rule." Manchester: The Scientific Publishing Company. 1s.

"Steam Engineering." By W. W. F. Pullen. Manchester: The Scientific Publishing Company. 4s. net.

"Physical Determinations." By W. R. Kelsey, B.Sc. London: Edward Arnold. 4s. 6d.

Catalogues and Lists.—Messrs. J. P. Hall & Co., of Oldham, have sent us a list of their motors for 500-volt circuits.

An advance copy of a new lamp list—showing large reduction in prices—comes to hand from the Improved Electric Glow Lamp Company. Silvered, silver inverted, opal, oval, shop window, tubular, conical, traction, and other styles are shown. The list is arranged in a businesslike way.

The Bastian electricity meters are fully described as to their principle, construction and action, in a list being sent out by the Bastian Meter Company, Limited, of Kentish Town.

A new and very fully illustrated catalogue has come to hand from Messrs. Graham, Morton & Co., Limited, of Leeds. It describes the firm's coal handling and elevating machinery as employed in a good many electricity works, machinery which is mostly familiar to our readers because of articles which appeared in these columns early in the present year. The catalogue should be interesting and serviceable to all engineers connected with the design, equipment or management of electricity works, who are interested in economical and labour-saving appliances.

The Lister Electric Manufacturing Company wish to bring before the trade their new illustrated catalogue and price list of dynamos, motors, &c. The list is based on an extensive range of standard patterns of multipolar type machines. The company emphasises the desirability of ordering standard sizes whenever practicable, but, of course, quotes for special requirements as well. We find in the list, which is now before us, details both in tabulated and specification form, of open, protected-enclosed, and fully-enclosed types for continuous current. Motor-starting rheostats, combined engines and generators, motor-generators and other lines, are also shown.

The new "Traction Supplies" pamphlet of the General Electric Company (1900), Limited, gives information regarding a great variety of tramway details, including line material, Wood's swivel trolley head, trolley standards for cars with and without top seats and life guards. Carbon brushes and gears (standardised to suit standard makes of traction motors) are stocked, standard motor parts and tools, rail cleaners, and patent safety devices for overhead lines are also in evidence.

Messrs. Pritchetts & Gold, Limited, of Feltham, have issued a new edition of their catalogue of stationary type accumulators. Prices and outputs of cells are arranged in table form, giving number of plates, and rates of charge and discharge, in glass or wood boxes. Yacht batteries in lead-lined teak boxes with acid-tight lids, and various instruments and accessorial sundries are particularised.

Sheet No. 22 of Messrs. E. F. Moy, Limited, details their motor-starting resistances fitted with "no voltage" release, or "overload" and "no voltage" release.

The New Century Arc Light Company, Limited, of Walworth, is circulating a sheet of its "New Century" arc lamps (open type), with metal brake and an emergency release to prevent hanging up.

The Electrical Company, Limited, have just brought out a new list of their electric incandescent lamps, of which their works supply many millions every year. They are made in all sizes and styles, and for any pressure required.

A number of pamphlets have been issued under date July, 1901, for inclusion in the recently circulated catalogue cover of the Johnson-Lundell Electric Traction Company. No. 51 deals with the Johnson-Lundell system of traction motors, controllers, and regenerative braking; No. 101, automobile and launch motors and controllers; No. 151, surface contact electric traction. The lists, with the intermediate numbers, will doubtless appear in due course.

The new edition of the catalogue of the Sturtevant Engineering Company, Limited, of Queen Victoria Street, E.C., has been entirely rewritten, and a number of new leaflets of the company's latest products in motor and dynamo-controlling apparatus have been added. The catalogue (dated 1902) is arranged so that new leaflets can easily be embodied in their proper positions. Illustrations are given of many new types, with revised prices. For convenience, illustrations and descriptions are given on the front of each leaflet, and prices and dimensions on the back. The new leaflets are as follows:—No. 31, Ironclad dynamo field regulators; No. 44A, Compound motor-starting and field-regulating rheostats; Nos. 50 and 50A, Rope-operated electric lift controllers; No. 51, Electrically-operated lift controllers; No. 80, W.T.L. circuit breakers; No. 91, Ironclad theatre dimmers. The modified leaflets are as follows:—No. 10, Multiple switch-starting rheostats for large motors; No. 12, Full reverse motor-starting rheostats; No. 65, Printing-press controllers; No. 73, Automatic solenoid pump-starting rheostats. A complete series of semi-enclosed and totally enclosed switches of the various standard types is now shown. The universal type-starting and speed-regulating rheostats, illustrated on leaflets Nos. 21 and 42, are all equipped with D.P. switches of the quick-break type, and the fuses for 220 and 500 volts are of the enclosed non-arcing type. Prices have been added for rheostats with renewable contacts in small as well as in large sizes. The Sturtevant Company are now manufacturing many of their rheostats in their London works. Every standard type of rheostat is to be held in stock in the warehouse of their London works, ready for immediate delivery.

Dynamo Brushes.—Mr. William Patterson, of Newcastle-on-Tyne, is supplying the "Matchless" self-lubricating dynamo brush, which is claimed to be a great advance on brushes of a metallic nature. The advantages claimed are as follows:—"The combination of the gauze with the lubricating compound gives the brush a beautifully soft and spongy contact, a perfect collection, friction is reduced to a minimum, an entire absence of sparking or scoring the commutator, giving the latter a highly polished surface with little if any wear. The compound is so applied to the fabric that a guarantee is given that the brush will retain its respective portion throughout, and will neither run, shake nor fall out under any circumstances."

Oldham v. Waring & Gillow.—This action was commenced in the High Court for the recovery of the balance of money alleged to be due to the plaintiff by defendants for electrical works carried out by him for the defendants at the Carlton Hotel, Edinburgh. Defendants, since the action was commenced, have admitted liability to the extent of £42 9s. 4d., and, by order of a Master in Chambers, paid that amount, with leave to defend as to the balance, being two sums for £35 10s. and £3 0s. 11d., as not having been ordered by them. On the application of plaintiff's solicitor, Mr. Jacobs, the case has now been remitted from the High Court to the Westminster County Court, and will come on for hearing on November 1st.

Shelby Lamps.—Messrs. R. A. Whyte & Co., 140, Bath Street, Glasgow, have taken up the sole agency in this country for the "Shelby" lamp as manufactured by the Shelby Electric Company. The success attending their efforts to place this lamp on the market has, we understand, been most satisfactory; they have had the lamp carefully tested by experts and Corporations, and the results obtained have been exceedingly good. This lamp is made on a new principle; it is exhausted from the top, thus doing away with tips. The filaments are shaped in such a way as to throw the light downwards, and the makers claim that their lamp gives more *useful* light than any other in the market. It has been stated that the vertical intensity of the lamp is of more practical importance than the horizontal intensity. This point is held to by the makers, and they have the testimony of well-known experts to show that their lamp has a distinct advantage as a light source in all cases where a lamp is to be used bulb downwards. Undoubtedly the larger number of electric lamps are used in a pendant position, and it is the rays that fall within a comparatively small space beneath them that actually serve the purpose of direct illumination, *i.e.*, of rendering objects visible. The makers lay stress on the fact that there is a wide difference between the production of light and the production of illumination; illumination, which is the end desired, is *light utilised*, or, in other words, the efficiency of light producers should be measured by the amount of light which is rendered available for actual use.

Telegraph Stores for Sale.—The Postmaster-General has 40 tons of gutta-percha, 100 tons of old copper wire, plates, &c., also various other wires, batteries, and a large quantity of red tape for sale. October 16th is the latest date for submitting tenders to C. E. Stuart, controller of stores, G.P.O. West, E.C.

Trade Announcements.—Mr W. Stamm, of 25, College Hill, E.C., has been appointed sole agent for the United Kingdom of Mr. Ernst Schiess, machine tool manufacturer, of Duesseldorf-Oberbilk. Heavy tools are a speciality.

The General Electric Company, of New York, announces the removal of its offices, on October 1st, from 110, Cannon Street, to 83, Cannon Street, E.C.

What the British Consuls Have to Say.—*News from Bangkok.*—Reporting on the trade of the consular district of Bangkok, Consular-Assistant Carlisle states that the Siam Electricity Company, a Danish concern with a capital of £150,000, has now practically absorbed the Bangkok Tramway Company, also Danish. The tramway is worked on the overhead wire system, and has been running for some years in Bangkok with much success. The company has also acquired the rights of a new tramway, 5½ miles long, running to Samsen, a suburb of Bangkok. The British Consul appears to be of opinion that there is room for improvement in the management of the tramways, for he expresses the hope that the Government will insist on certain reforms in connection with those lines. He states that while they are, no doubt, a great boon to many thousands, the disgraceful condition in which parts of the permanent way have been kept in past years, and the speed at which the cars often run through the crowded streets, constitute a danger to foot and carriage passengers such as would hardly be tolerated in any other country. Under the new management the tramways will obtain their power from the electric light station.

Consular-Assistant Carlisle, referring to the numerous fires which have occurred of recent years in Bangkok rice mills, states that the matter has become a serious question. Five mills were burnt down in 1900, the loss, which fell mostly on British insurance offices, being over £100,000. The cause of the fire, he states, is never known; in some cases it is attributed to incendiarism on the part of some aggrieved coolie, but he thinks that more often the cause is due to the fall of a kerosene lamp. He therefore suggests that it would be well if the insurance companies were to insist upon the use of electric light or vegetable oils only in the mills.

Italy, a Market for British Stuff.—The Anglo-Roman Gas Company, which has a reserve fund returned at £141,443, chiefly invested in real property, Italian Government consols, and railway shares, has obtained the necessary concession for the electric supply of Rome, where it is anticipated that in consequence of the gradual but persistent introduction of electricity as an illuminating agent, the demand for British coal for gas-making purposes will, in the near future, fall off. And inasmuch as the Tivoli waterfalls supply Rome gratuitously with sufficient electric energy to light every street and house in the city, the British Consul at Rome is of opinion that when a reduced tariff comes into force, gas will be dispensed with altogether. Hence, he believes that there will shortly be a good market open for British electric appliances of all kinds, both in Rome and in other towns of Northern Italy where electricity is supplanting gas.

The Electric Railways and Tramways Company (Italy), which was started quite recently, claims to represent the former Thomson-Houston International Company, later on known under the style of the Thomson-Houston Mediterranean Electric Company, and has for its object the building of electric tramways in Rome, in addition to those which already belong to the kindred Roman concern, the Tramways and Omnibus Company, as well as of carrying out the long expected plan of connecting Rome with the small towns in the neighbourhood such as Frascati, Grottaferrata, Oslia-on-the-Sea, Rocca di Papa, Castelgandolfo, &c., all of which are favourite summer resorts for the Italians. According to a recent report of the British Consul at Rome, the subscribed capital of the company amounts to £60,000, of which three-tenths only have been called in. That capital, however, he thinks, does not seem quite adequate to carry out the costly works which the directors enumerate in their prospectus. Moreover, up to the present the company has only prepared the general survey of the proposed lines, and as there are no visible traces of its activity, with a strong competitor like the existing tramways and omnibus company, the British Consul is of opinion that it will be a matter of some difficulty for the company to carry out its programme.

It is reported that a firm of railway contractors and electricians have applied to the Italian Government for a concession to build an electric railway from Rome to Naples by means of which the journey, which now takes five hours, would be reduced to half that time. The scheme is being considered by the Commissioners of Public Works.

British Electrical Firms and Russia.—The articles of British production in which more business can at present be done with Russia, in spite of the keen competition of similar goods of German and North American origin, Consul-General J. Michell (St. Petersburg) states would seem to be electrical machinery and appurtenances, machine tools, hand tools, cutlery, agricultural machines, &c.

The electric tramway and lighting contract for supplying the town of Archangel with electric traction and lighting, which was signed in 1897, Sir Capel C. Wolseley, the British Vice-Consul reports, seems no nearer fulfilment now than it was then. Consul Woodhouse states in a report received at the Foreign Office on August 16th, that the electric trams at Riga, or at least, the first section thereof, were opened a short time ago. Electric cranes are used at the fort of Pernau (Russia) for discharging coal from steamers. The wood-pulp mills at Pernau, which have been erected by a German company at a cost of about £700,000, and commenced operations in the autumn of 1900, are equipped with the most modern machinery and appliances, including a very powerful electric driving and lighting plant, all having been imported from Germany.

West African Telegraphs.—Telegraphic communication between the port of Chinde (West Africa) and Chiromo would appear to be very unsatisfactory, for, according to the report of Vice-Consul Stanley Hewitt-Fletcher, the telegraph line between the two places was frequently out of order during last year, and even when working the messages were not always correctly transmitted. There is no submarine cable station at Chinde, and the only means of through telegraphic communication with Europe is by this line. The telegraphic isolation of Chinde, Vice-Consul Hewitt-Fletcher states, has proved a source of serious inconvenience on several occasions.

American Plant for Japan, &c.—The exports of electric light machinery from the United States to Japan are reported to have increased from 99,253 yen in 1893 to 478,215 yen in 1900. The exports of scientific instruments, including telegraphic, telephonic and other electric apparatus, to all countries during the year ending June 30th, 1901, increased 14 per cent. The United Kingdom was the largest buyer with $2,105,611, an increase of 83 per cent. compared with 1900.

German Plant at Chili.—The Chilian Electric Light and Traction Company is described by Vice-Consul A. C. Kerr (Santiago) as a very large enterprise, which, although all the material is of German manufacture, yet depends in a great measure on British capital. This company is now running 150 cars in Santiago. The work of the company in connection with the Maipu River, Vice-Consul Kerr states, has unfortunately not proved a success, the water-power not proving sufficient; hence the work has been abandoned after an expenditure, it is said, of some £40,000. The motive power will now be steam, the company possessing an excellent central station in Santiago. Up to the present, the company has made greater progress in the traction part of its scheme than in the lighting, although some thousands of lights are now installed, and by the terms of the company's contract with the municipality, the streets will be finally lit by them.

Wiring Table.—A neat card for electricians, giving the "safe" capacity at 1,000 amperes per sq. in. of 37 sizes of wires and cables, both in amperes and in 16-c.p. lamps of various voltages, has been issued by Mr. R. H. Waite, of York. The idea is a good one, and has often been carried out before, but we have yet to see a card in which the current-carrying capacities are given on a scientific basis, such as that embodied in the regulations suggested by the Institution of Electrical Engineers. The 1,000-ampere rule has served its turn in the past, but as a criterion of safety it is obsolete, and now that the use of high voltages has become common, the limit of gauge set by the voltage drop is seldom touched by the smaller wires, which are those most heavily under-rated by the old rule. It is high time that this "wireman's Shibboleth" should be abolished.

ELECTRIC LIGHT AND POWER NOTES.

Accrington.—An inquiry has been held by Mr. M. K. North, L.G.B. inspector, respecting the application by the Corporation for leave to borrow £8,893 for electricity extensions.

Bognor.—The authorities have decided to light the town with electricity. The work is likely to be commenced as soon as the loan is obtained.

Boyle.—The town of Boyle is now equipped with a complete electric lighting installation, the electrical energy being derived from turbines driven by the river which passes through the town. The Town Commissioners entered into arrangements with a local miller, Mr. Hugh Stewart, by whom the plant has been provided. The principal streets are lighted with arc lamps, and the outlying districts with 50-c.p. glow lamps.

Bristol.—The Electrical Committee has considered the report of the engineer on the working of the Avonbank station, and approved of the arrangements proposed. Mr. Leopold de R. Du Verge has been appointed assistant engineer. The Committee considered tenders for the wiring of the Avonbank works for lighting purposes, and provisionally accepted that of Messrs. Buchanan and Curwen. A scale of charges for automobile charging was adopted for one year as an experiment.

Burnley.—The Guardians have resolved to spend a sum not exceeding £8,806 on the erection of a boiler house and workshops, the provision of boilers, and the erection of works for lighting the workhouse by electricity.

Chepstow.—The electric lighting syndicate has submitted a draft agreement to the D.C., in which a maximum price per unit of 6d. is specified. Yet the D.C. wants a lower maximum! There seems to be no limit to municipal greed and oppression.

Chiswick.—The D.C. has decided to apply to the B. of T. for a provisional order to supply electrical energy within the district.

Hebden Bridge.—The D.C. has decided to obtain a prov. order with a view to supplying electricity to the district.

Hull.—The E.L. Committee proposes to carry out extensions of the electric lighting plant at a cost of £42,000.

Hungary.—Tenders have just been invited for the installation of a complete electric power plant in the State tobacco factory at Kassa.

Knaresborough.—The U.D.C., amongst other improvements, is considering the introduction of electric light and power supply into the district.

Leicester.—The accounts of the electricity department for the half-year ending June 30th last show a balance of £997 9s. 6d., after paying interest and sinking fund.

Liverpool.—Councillor Utley, who has apparently constituted himself "candid friend" to the E.L. and P. Committee, continues to declaim against the charges for electric lighting, defying the Committee to prove that the cost of energy for traction is only 1·2d. per unit, while for lighting it is 3·2d. per unit. In this Mr. Utley is obviously mistaken, and the Committee evidently holds this opinion. We have often remarked on the injustice likely to occur in a combined lighting and traction station, owing to the tramway department being sacrificed to the lighting department, and this is what Mr. Utley is endeavouring—unsuccessfully, we hope—to bring about.

Longton.—The Corporation recently inaugurated an electricity supply installation at the municipal gasworks. The generating plant, which cost about £21,000, was supplied by the Electric Construction Company, Limited, of Wolverhampton; the installation was designed by Mr. W. Langford, engineer and manager of the gasworks.

London.—City.—The letter addressed by the City of London Electric Supply Company to the Corporation was referred to the Streets Committee at the meeting on Thursday last week.

Westminster.—The public electric lighting system for the St. George's section of the City of Westminster has been completed, and shows a marked improvement on the incandescent gas lamps which have done duty for several years.

Battersea.—On Saturday last the formal opening ceremony of the electricity works of the Battersea Borough Council was performed, in the presence of a large company of spectators. Among the speakers were Messrs. W. Davies (mayor of the borough), J. E. Livsey (chairman of the Electric Lighting Committee), J. Burns, M.P., and other Councillors and visitors. The lights were to have been switched on by Mr. A. M. Torrance, chairman of the London County Council, at 5.50 p.m., but owing to an error on the part of the Committee as to the hour of sunset, it was thought necessary to prolong the speechmaking until 6.30, "so that the lights could be seen." An illustrated description of the station will be found elsewhere in this issue.

Manchester.—On Wednesday last, the Electricity Committee recommended that application be made to the L.G.B. for borrowing powers to the amount of £477,000 for electricity purposes. This amount will provide £350,000 for additional plant at the Stuart Street works and 10 sub-stations; £30,000 for two turbo-generators of 3,000 H.P. each, to replace at least four of the 400-H.P. engines at the Dickinson Street works; £82,000 for the completion of Dr. Kennedy's scheme, and £15,000 for laying cables to Denton sub-station. It is expected that the installation of the turbo-generators at Dickinson Street station will result in a saving of at least £3,000 per annum in coal, oil and wages, whilst the output of the engine room will be increased by at least 1,200 H.P. without any fresh boilers being added. In regard to the proposed extensions at Stuart Street, the engineers report that the whole of the Dickinson Street and Bloom Street works, and the first portion of the Stuart Street plant being fully requisitioned for by existing demands, and probable future demands for current for both lighting and traction purposes, it has become an immediate necessity to anticipate future demands by installing additional plant at the Stuart Street works.

Nairn.—Acting on the advice of ex-Bailie Mackenzie, of Edinburgh, a committee has resolved to recommend the T.C. to procure a prov. electric lighting order.

Pontypridd.—The Board of Guardians, after examining tenders, the lowest of which was £1,520, has resolved not to adopt electric lighting for the union workhouse.

Singapore.—A recent Colonial Office report indicates that electric lighting and tramways are badly needed in Singapore, and the municipality is likely to take steps to introduce them shortly.

South Staffordshire.—Mr. G. Howl, the general manager and secretary of the South Staffordshire Mines Drainage Commissioners, in his annual report says the Midland Electric Corporation for Power Distribution, Limited, have pushed forward almost to completion their electric power station at Ocker Hill, and they are now busily engaged in laying cables in several parts of the Commissioners' district. There is, therefore, every prospect of electrical energy being available next year for the working of the proposed centrifugal pumps to drain the low-lying areas situated below brook level.

Southampton.—At the last meeting of the T.C. the Finance Committee reported the receipt of a letter from the L.G.B. relative to the application of the Council to borrow £4,000 for the extension of generating plant, stating that the Board would defer further consideration of the application until a satisfactory settlement had been arrived at with regard to the financial position of the borough. With regard, however, to the application made by the Council for sanction to borrow £600 for laying a cable to supply the Ordnance Survey Office with electric power, in view of the representation of the Director-General of the Ordnance Survey as to the urgency of the work, the Board had decided to comply with the application. The town clerk had been directed by the committee to ask the Board to reconsider their decision with regard to the application for sanction to borrow £4,000 in view of the urgent necessity of the extension work being completed before the commencement of the winter season.

Spain.—A central electric lighting station has just been completed and put in operation at Vignera (province of Lagrono). Water power is utilised, the plant comprising a horizontal turbine developing 110 H.P., and a 55-KW. two-phase alternator. The plant supplies current for lighting purposes at Vignera, Nalda, Istallana, Albelda, Alberite and Villamediana.

Strabane.—The lighting of Strabane, County Tyrone, says the *Gas World*, is at present under the consideration of a Committee of the Urban Council. At a meeting of the Committee a few days ago Mr. S. B. Langlands and Mr. R. J. Skinner attended to give advice in regard to the lighting of the town by gas, and Mr. R. K. Steele, of the Westinghouse Company, was present to give his advice regarding electricity. Mr. Langlands expressed his approval of an estimate submitted by Mr. Skinner to provide new gasworks and plant for the sum of £15,000. Mr. Steele, on behalf of the Westinghouse Company, stated that he was prepared to send in another estimate to the Committee to provide electric light for both public and private purposes, and also to supply gas for heating and cooking purposes, at a total cost of £17,000. After a long discussion, the Committee asked the Westinghouse Company to send in their new estimate, and also decided to obtain plans and specifications for developing the present gasworks.

Tottenham.—The D.C. has resolved to apply for a prov. order. This is one of the districts concerned in the North Middlesex Electricity Bill, which was dropped in consequence of the adverse results of the voting in two of the parishes.

Waterford.—Messrs. Lacey, Clirehugh & Sillar have presented the Corporation with a report dealing with the whole question of lighting the town by electricity.

Worcester.—The City Council has resolved that a sum of £27,461 be expended in the erection and equipment of a supplemental electricity generating station in the city, in view of the conversion of the city tramways and light railways in the immediate district to electric traction, in the proportion of £7,180 for the buildings, and £20,281 for the plant.

ELECTRIC TRACTION NOTES.

Antwerp—Brussels.—The *Financial Times* quotes a Brussels journal to the effect that the Belgian Government has accepted, subject to the sanction of Parliament, the scheme proposed by M. Empain, a Belgian banker and financier, for the construction of an electric railway between Brussels and Antwerp. M. Empain (our contemporary believes) is the guiding spirit of the Paris Electric Metropolitan Railway Company.

Ayr.—The Corporation electric tramways were opened for public traffic on 26th ult. There are 3¾ miles of route. Mr. A. J. Fuller is the electrical engineer and Mr. F. Coutts general manager. The members of the Corporation, contractors' representatives, and invited guests went over the line in four cars, and a banquet followed. Messrs. Callenders laid the cables, Messrs. Lowden Bros. supplied the overhead equipment, Mr. D. Murray, of Glasgow, carried out the permanent way work, and Messrs. Hurst, Nelson and Co. supplied the cars.

Barnsley.—The T.C. is asking the B.E.T. Co. to alter the gauge of the line in Barnsley so as to make it identical with the proposed line from Barnsley to Doncaster.

Birkenhead.—The new electric tramway routes in Borough Road, Prenton Road and Shrewsbury Road, and from Woodside Ferry to Shrewsbury Road, Birkenhead, were inspected by Lieutenant Von Donop, representing the Board of Trade, on Friday last. The cars were started for passenger traffic in the evening.

Bradford.—Three new electric routes have been determined on by the Corporation—Church Bank and Otley Road, Little Horton Lane and Wakefield Road to Tong.

Carshalton.—Mr. J. Clifton Robinson attended the meeting of the U.D.C. last week to explain the L.U.T. schemes for about two miles of tramways proposed for the Council's district, but he declined to go into details of widenings needed until sundry negotiations were completed. At the same meeting Mr. Hederstet, Mr. Hughes and Mr. Ratcliff Hume, representatives of the B.E.T. Co. also attended, saying that the 440 miles of electrical tramway in which their company were concerned included the Croydon system, which was leased from the Corporation. Mr. Hederstet then gave full details of his company's proposed lines from Croydon to Wimbledon, and produced a plan showing in detail the street-widening they proposed to effect at their own cost. Their system would have the advantage of a physical junction with the Croydon and L.C.C. systems, and they hoped to obtain a lease of the Mitcham light railway order. Mr. Robinson, by the way, expressed equal confidence of obtaining the Mitcham order.

Darlington.—The General Purposes Committee is to apply to the Light Railway Commissioners for an order for the Corporation to put down electric tramways.

Dewsbury.—It is reported that the B.E.T. Co. have agreed to purchase the Dewsbury, Batley and Birstall (Steam) Tramway Company's undertaking. All the local authorities, with the exception of the Batley Corporation, have given notice of their intention to purchase their respective sections of the undertaking, and either sell them or lease them to the Traction Company. The Batley Corporation had also, subject to approval of the B. of T., decided to purchase the section within their borough, and run electric cars. The price to be paid for the concern will be about £30,000. The greater portion of the line, which is about 4 miles in length, is within the borough of Batley. If the sale takes place, Batley Corporation with then have to deal with the B.E.T. Co. instead of with the local company.

Dover.—With the extension of the boundaries of the city it is proposed to continue the municipal electric tramways to Kearsney and River.

Greenock.—The B. of T. has inspected the reconstructed permanent way for the electric tramways in Greenock, Port Glasgow, and Gourock. After the electrical equipment of the line has been completed another inspection will take place.

Halifax.—Owing to the scarcity of water, it was feared last week that it would be necessary to stop the tram service. The *Bradford Observer* for September 27th said:—"Either the electric lighting or the tram service must perforce be stopped, and it is felt that the tram service must give way. The difficulty of continuing both branches is caused by the stoppage of the flow of compensation water down the Hebble brook. The electricity works require for condensation purposes 750,000 gallons per day, and the supply from the reservoirs is being cut off."

Keighley.—Last week we stated that the borough engineer had been instructed to prepare estimates for the overhead equipment of the tramways. We hasten to correct this statement, as we learn that Mr. J. M. Smyth, the borough electrical engineer, has been requested by both the Electricity and Tramways Committees to prepare estimates and carry out all the electrical work, including overhead line and cars for the tramways. The borough engineer is responsible for the permanent way.

Leamington.—The report of the Leamington and Warwick Tramways and Omnibus Company says that a provisional order for the working of the tramways by electric traction in the borough of Leamington has now been granted, and arrangements for converting the line for working by electric traction are in progress. Mr. Emile Garcke has been appointed chairman of the Company.

Leicester.—The T.C. has concluded an agreement with the Tramways Company for the sale of the undertaking to the Corporation at the price of £110,210 upon terms which include the liability of the Corporation to pay off the sum of £23,900 borrowed on debentures by the company.

Maesteg (Central Glamorgan).—The advisability of having electric cars for the district is being ventilated. The report of the electrical experts, whom the Urban Council have decided to engage, on the issue of providing electric light for the district, is being awaited with interest.

Manchester.—Another route of the Manchester electric tramway system was opened on Monday, by which the district of Hightown is connected with Deansgate. The cars run through Waterloo Road to Strangeways, and have been patronised by a considerable number of passengers.

Mersey Railway.—At the half-yearly meeting of the Mersey Railway Company, Limited, held last week at Worcester House, London, the chairman, Mr. James Falconer, in the course of a statement as to the position of the company, announced the terms on which the British Westinghouse Electric and Manufacturing Company had undertaken to substitute electric traction plant and rolling stock for the steam engines and rolling stock which had been in use since the opening of the line. The Westinghouse Company, he said, had entered into an agreement to construct works ample for operating a specified train service, and the railway company were to have a 12 months' trial of the plant, putting it under the care of any engineer they chose. Should any additional works be found necessary, the contractors would supply them without extra payment. They guaranteed that the line should be worked at a cost not exceeding 6¾d. per train-mile, the present cost on corresponding items of expenditure being 1s. 3d. per train-mile. The Westinghouse Company will guarantee the interest on the existing 4½ per cent. redeemable first debenture stock, which amounts to £249,276, until the works are available for public traffic, and will find money to redeem the existing redeemable stock. The contract price, to cover the works and financial provisions, was £635,303, payable to the extent of £620,000 in 4 per cent. first perpetual debenture stock and £15,000 in cash. The period for the completion of the works is 18 months, and the directors hope that early in 1903 the traffic of the tunnel will be worked by electric traction. Mr. Charles Birchell, a Liverpool shareholder, adversely criticised the policy and management of the directors of the Mersey Railway Company, and also the arrangement of the Westinghouse Company. He offered, if the directors would make their exit, to find a Lancashire company who would find the money and construct the works on terms more beneficial to the shareholders. He estimated that the Westinghouse Company would make a profit of £74,797 on the transaction, and still hold £620,000 of the company's debenture bonds. The report as presented at the meeting was carried by a large majority.

Northampton.—The T.C. is to purchase the local tramways for £37,500.

Portsmouth.—Since the starting of the electric cars on the main route, there has been a large accession of traffic. The remainder of the work is being vigorously pushed forward by the contractors (Messrs. Dick, Kerr & Co.)

Reading.—The Corporation has taken over the tramways, which will be converted to overhead trolley. The company receives £12,000.

St. Helens.—The Tramways Company has drawn the attention of the St. Helens Electric Supply and Tramways Committee to the fact that the cables which were laid down for the purposes of the tramways system were being used for the purpose of supplying other firms with electrical energy, and asking what allowance the Committee proposed to make to the company in respect of the cables so used.

Surrey.—The various local authorities concerned with the new tramway proposals of the L.U.T. and the B.E.T. Co. between Kingston and Croydon have decided to hold a joint conference on the subject of meeting the companies' proposals.

Sutton.—The U.D.C., having received a report on the general subject of tramways, had an interview with representatives of the B.E.T. Co. regarding the latter's local tramway proposals. The interview was adjourned for the production of plans.

The Underground.—The B. of T. arbitrator, Hon. A. Lyttelton, K.C., M.P., has fixed the 7th inst. for the preliminary meeting of his tribunal, which is to decide upon the dispute between the Metropolitan and the District Railway Companies.

Wimbledon.—The U.D.C. have had an interview with the engineer of the B.E.T. Co. regarding the company's proposed extension of the Croydon tramways to their district.

TELEGRAPH AND TELEPHONE NOTES.

The Australian Federal Parliament and Cable Traffic.—At Melbourne in the course of the proceedings in Committee on the Post and Telegraph Bill, Senator Sargood (Vic.) moved the addition to postponed clause 89, dealing with the order of transmitting telegrams, providing that persons sending telegrams should be able to state by which route the messages should be sent. If the Postal Department had the right of depatching messages by whatever route it chose, then the present system entered into by South Australia and New South Wales with the Eastern Extension Company would be at once nullified. The public should be able to decide upon the route of despatch. Senator Drake (Q.) disagreed with Senator Sargood as to the advisability of the proposed addition to the clause. He had been assured that the Pacific cable would be ready in March next, and he thought it would be disastrous for all concerned if at the dictation of the senders of messages privately owned lines were blocked with business while the line subsidised by the Government was laying idle. Another effect of the privilege would be that people having stipulated the route by which a telegram should be sent could easily go to the company and arrange terms with it. Senators: Why not? Senator Drake: Why should not the department have the right to decide by what route its own business should be sent? Senator Miller agreed with Senator Sargood's proposal, and urged that cable communication for the people should be as cheap as possible. If the Department was empowered to do what it liked, he could easily see that the State-owned cable would be choked with messages at high rates, while the private lines were bare of business. Senator Walker (N.S.W.) wanted as many telegraphic services for the public as possible, and favoured cheap rates. Senator Playford pointed out that when the Pacific cable was open for business, and there was no doubt that the department would rely almost entirely upon it, the overland line to Port Darwin, which had been constructed at great cost by South Australia for the benefit of the whole of the continent, would be practically thrown aside, and left to remain a heavy loss to the Commonwealth. Senator Drake assured the Senate that it was only in anticipation of the Pacific cable being opened at an early date that the private companies had lowered their rates. If they could succeed in ousting the Government from the field of competition, then the rates would certainly be raised again. The proposed addition to the clause was mischievous in principle, and designed to promote the welfare of one company. After further discussion Senator Sargood's amendment was lost on division by 16 votes to 9, and the clause was agreed to as printed.

Bradford Telephones.—The Bradford Corporation has issued an invitation to the other County Boroughs in the West Riding of Yorkshire to meet and discuss the question of the advisability or otherwise of a municipal telephone service.

Folkestone Telephones.—A sub-committee of the Council is negotiating with other authorities in the Folkestone telephone exchange area with a view to co-operating in a municipal system. Mr. A. R. Bennett is to be asked to advise.

Telegraph Letter-Ciphers and Telegraph Rates.—

Mr. C. Edmonstone Ross, Examiner of Accounts, Public Works Department, India, has submitted to the Bureau International des Administrations Telegraphiques, at Berne, some suggestions with reference to letter-ciphers, which seem well worthy of consideration. The suggestions put forward aim at completely changing, not only the principle upon which charges for telegrams are based, but also the actual method of signalling itself. Mr. Ross points out that it is hardly equitable to make the same charge for a word of four letters as for one of ten letters. But if we can so arrange that each word in a message is represented by the same number of letters, and each letter by the same number of signals, there seems to be no reason why the unit of charge should not be a signal instead of a word. His suggestion, therefore, is to withdraw the present restrictions as to the use of letter-cipher, *provided each letter used requires the same number of signals*, and to charge for such letter-cipher on a signal basis. With this object he would assign to each word a certain number of the same sort of letters, that is to say, letters each of which require the same number of signals, and to fix the tariff for messages in letter-cipher of this description at so much for so many signals. He suggests as a reasonable rate, 24 signals for the present or future charge per word, whatever that may be.

Figure-cipher, which is permissible (owing to uniformity in signalling), is at present charged for at the rate of five figures to a word, and as each figure requires five signals, the existing rate is actually equivalent to 25 signals per word. The length of a word in a foreign message is limited to ten letters. As the average number of signals per letter in the telegraph alphabet is 3·15, therefore a word of ten letters requires on an average 31½ signals. The suggested rate is thus well within this limit.

In the telegraph alphabet there are eight letters which require three signals each, and twelve which require four signals each. Thus a vocabulary of 32,768 words could be compiled by assigning *five* 3-signal letters to each word, or a vocabulary of 20,736 words by assigning *four* 4-signals letters to each. Under the proposed rate of 24 signals per word, *eight* 3-signal letters or *six* 4-signal letters would be charged as a word. Therefore it is obvious that a message consisting of, say, 10 vocabulary words, *i.e.*, 50 letters under the 3-signal system, or 40 letters under the 4-signal system, would be charged for, in either case, as seven words only, thus demonstrating a saving in cost of transmission of 30 per cent.

The advantage of cipher telegraphy is that it renders possible the codification of almost any conceivable sentence, provided the vocabulary is extensive enough, whereas ordinary word codes provide for a necessarily limited selection of phrases only. Simple vocabularies could be arranged containing a selection of about 5,000 words, which would probably be more than sufficient for all ordinary requirements, and the whole thing could be published in a volume of pocket-book size at a much lower price than that of the cheapest of existing codes.

Mr. Ross points out that absolute secrecy, an important essential in a code, could be secured by the simple expedient of adopting a preconcerted arrangement as to the order in which to read various groups of letters.

Under existing telegraphic regulations, *figure*-cipher messages are permissible in international traffic, but *letter*-cipher is prohibited. The reason for this is because of the extreme liability of error, *i.e.*, substitution of one letter for another, in ordinary letter signalling, due to the fact that each letter in the telegraphic alphabet is not represented by a *uniform* number of signals. For example, E is represented by *one* short signal, I is represented by *two* similar short signals, and S represented by *three* similar short signals. Thus, the letter S is liable to be, and, as a matter of fact, frequently is, signalled and read as E I or I E.

This objection, Mr. Ross points out, does not apply to figure-signalling, because the number of telegraphic signals is uniform for each figure, *i.e.*, five signals for each figure. Figure-cipher messages are, therefore, admissible, and are charged for at the rate of five figures to a word, that is to say, 25 signals to a word.

Now, there are certain letters, viz., D, G, K, O, R, S, U and W, each of which is represented in the telegraphic alphabet by a uniform number of *three* signals, and it is obvious, therefore, that a letter-cipher message composed entirely of these "3-signal" letters possesses the same advantage, for signalling purposes, as a figure-cipher message, with the additional merit that only 3 signals go to a letter, instead of 5 to a figure. (Of the other letters, two have signal, four have 2 signals, and 12 have 4 signals each.)

There seems to be no reason, therefore, why letter-cipher messages, *consisting only of "3-signal" letters*, should not be permitted, and the tariff for such messages fixed, as suggested, on a letter or signal basis instead of on a word basis.

Mr. Ross further suggests the use of a telegraphic signalling apparatus that would consist of a key-board with five keys numbered 1 to 5 (to be worked with the fingers of one hand) at the despatching end, and a recording apparatus at the receiving end that would record the figures *in type* as signalled.

Given such an instrument, he would substitute, in lieu of the present combinations of dots and dashes in the Morse alphabet, the following alphabet:—

Letters (Vowels.)	Proposed figure signals.	Letters (Consonants.)	Proposed figure signals.	Letters (Consonants.)	Proposed figure signals.
A	11	B, P	12, 21	H, Y.. ..	24, 42
E	22	C, S	13, 31	L, R.. ..	25, 52
I (also J) ..	33	D, T	14, 41	M, N ..	34, 43
O	44	F, V	15, 51	Q, W ..	35, 53
U	55	G, K	23, 32	X, Z	45, 54

Figures and marks of punctuation, &c., could be represented by combinations of two letters each. The 10 numerals, for instance, could be represented by the 10 pairs of consonants shown above.

Amongst other advantages claimed for the proposed system are:—"The alphabet is very much easier to learn than the Morse alphabet. The vowels, it will be observed, consist of double signals, thus A is 11, E is 22, and so on. The consonants are grouped in 10 pairs, arranged phonetically as far as possible, and each of the pair is represented by the same two signals but in different order; thus B is 12 and P is 21, M is 34 and N is 43, and so on. Therefore, all that the learner has to commit to memory is (*a*), the pairing of the letters (the phonetical arrangement renders this extremely easy to memorise), and (*b*) the figure signals for the first of each pair. That is to say (excluding vowels), he need remember 10 signals only of two symbols each, instead of double that number of complicated combinations of dots and dashes.

Each letter requires two signals only. The whole alphabet could thus be signalled with 52 symbols, whereas under the present "dot and dash" system 82 symbols are necessary for the 26 letters. This is equivalent to a saving of more than 36 per cent. in signalling work.

The number of signals for each letter is uniform. In the Morse system the number of signals varies from one to four for each letter, thus often causing mutilation in transmission; for instance, S and I E are undistinguishable from each other in the Morse alphabet. Such mistakes would be impossible with a uniform number of signals to each letter.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899 ..	..
Para-Maranham	March 1, 1900 ..	..
Cadiz-Teneriffe	Aug. 6, 1901 ..	..
Bissao-Bolama	Aug. 16, 1901 ..	..
Curacao-Coro	Sept. 5, 1901 ..	..
Gibraltar-Tangier	Sept. 13, 1901 ..	..
Zanzibar-Mombassa	Sept. 27, 1901 ..	..
Landlines:—		
"*Via* Hanekin" on Persian territory ..	Feb. 24, 1900 ..	..
Pekin-Kalgan	June 14, 1900 ..	..
Maimatchin-Kalgan	June 30, 1900 ..	..
Communication with Baranquilla and Cartagena towns of Venezuela	Dec. 8, 1900 ..	..
"	Oct. 31, 1900 ..	..

Wireless Telegraphy.—The United States Meteorological Department are reported to be about to adopt a system of wireless telegraphy between San Francisco and the meteorological station on the Farallonen Islands, 30 miles away.

The Berlin correspondent of the *Daily Chronicle* says that wireless telegraphy was for the first time employed on a large scale at the recent German manœuvres, and the result is stated to be eminently satisfactory. Five balloons were supplied with instruments for receiving and dispatching messages by wireless telegraphy, and not a single message went wrong. Communication was also kept up between his Majesty on the manœuvre ground and the Admirals of the fleets lying in Danzig Bay.

The Cunard steamer *Lucania*, which arrived at Liverpool on Saturday morning, reported that she had been in communication at sea, on Wednesday last, with the same company's outward bound steamer *Campania*, which left Liverpool on 21st ult. The communication lasted two hours. The ships were 36 miles from each other when the conversation took place, and were not visible to each other at any time.

CONTRACTS OPEN AND CLOSED.

OPEN.

Batley.—October 18th. Lancashire boilers, economiser, condensing plant, piping, crane, &c., for electricity works. Engineers, Lacey, Clirehugh & Sillar, Westminster.

Boulder City.—November 23rd. The Council invite tenders from manufacturers for the construction of a tramways system, plans and specifications of which are to be seen at the office of the Agent-General, London. See "Official Notices" September 20th.

Blackpool.—October 21st. Tramway poles, cables, overhead work, electric car equipment, &c., for the Corporation. See "Official Notices" September 27th.

Darlaston.—October 18th. Construction and reconstruction of 8 miles of tramways between Wolverhampton and Darlaston, for the British Electric Traction Company, Limited, on behalf of the Wolverhampton District Electric Tramways, Limited. The electrical equipment of the tramways not included. Chief Engineer, Donington House, Norfolk Street, W.C.

East London (S.A.).—November 26th. Tenders to Mr. R. N. Moir, Town Clerk, for 50-kw alternator and engine. London agents, Dyer & Dyer, Aldermanbury, E.C.

Glasgow.—October 8th. Two miles of 2-in. pipes for the Corporation electricity department. Specifications from Mr. Chamen.

Great Western Railway.—October 21st. The directors want tenders for a year's stores, including (17) India-rubber goods; (18) Telegraph instruments; (19) Telegraph apparatus; (20) Copper

wire, G.P. wire, &c.; (21) Telegraph ironwork and tools; (22) Telegraph drysalteries; (23) Electric light carbons; (24) Electric lamps, incandescent; (51) Telegraph poles and yellow pine.

Greenwich.—October 10th. Installation for lighting the new Children's Homes for the Guardians. See "Official Notices" September 20th.

Hackney.—October 7th. The electric lighting of the Hackney Workmen's Club, 27, Haggerston Road. Can be viewed 11 a.m. to 3 p.m. W.McNiell, secretary.

Huddersfield.—October 12th. Six car bodies, trucks and equipments. Corporation. See "Official Notices" September 20th.

Ilford.—October 7th. Wiring, &c., 200 lamps, for Downhall School for the Ilford School Board. Specifications (£1 1s. 0d.) architect, C. J. Dawson, 7, Bank Buildings, Ilford.

Italy.—The municipal authorities of Pagani (Salerne province) have just invited tenders for the concession for the public and private electric lighting of the town during a period of 28 years. The public lighting will comprise 40 continuous-current arc lamps, eight alternating current arc lamps, and 159 16-c.p. incandescent lamps.

Kirkcaldy.—October 14th. Main switchboard. Corporation. See "Official Notices" September 20th.

Leeds.—October 8th. Main switchboard to deal with output of three 1,500-kw. two-phase alternators. See "Official Notices" September 13th.

Leeds.—October 15th. Fifty electric tramcars. Deposit 10 guineas to T. Hewson, City Engineer, Municipal Buildings, or Hopkinson & Talbot.

London.—October 8th. (Contract No. 1) track rails and fastenings; (2) slot rails and fastenings, tiebars, and conductor tees; (3) roadwork and platelaying required for the reconstruction on the conduit system of the tramway routes between Westminster Bridge, Blackfriars Bridge, and Waterloo Station respectively, and Tooting, for the London County Council. Specifications, &c., at the Engineer's Department, County Hall, Spring Gardens, S.W.; £2 each for Contracts Nos. 1 and 2, and £5 for Contract No. 3. Nos. 1 and 2, British manufacture.

Manchester.—October 9th. Tenders for cables for Electricity Committee. See "Official Notices" September 27th.

Newport (Mon.).—October 21st. Coal handling winches, piping, switchboard, cables, cable ways, overhead construction, electric motor car, repair shop equipment, and steel chimney shaft for the tramways and power supply undertaking. See "Official Notices" September 20th.

Sardinia.—Working all the Sardinian mines by electricity. Signor G. Merlo, chief mining expert of the Sardinian Mining Association, Iglesias, Sardinia. 3,000-h.p., water power.

Spain.—October 12th. The municipal authorities of Villar del Arzobispo (Valencia province) are inviting tenders until the 12th inst. for the concession for the electric lighting of the town during a period of eight years. Tenders are to be sent to El Secretario del Ayuntamiento de Villar del Arzobispo (Valencia), whence particulars may be obtained.

Spain.—October 17th. Tenders are being invited until the 17th inst. by the Spanish Ministry of Public Works in Madrid for the concession for the construction and working of an electric tramway between Linares and Las Minas. Tenders are to be sent to La Direccion General de Obras Publicas, Madrid, whence particulars may be obtained.

Stepney.—October 17th. Arc lamp columns, lamps, fittings, switchboard, for Council's electricity works. See "Official Notices" September 27th.

Stourbridge.—October 18th. Construction of 2½ miles of tramways at Stourbridge, for the British Electric Traction Company, Limited. Electrical equipment not included. Specification, &c., £5. Chief engineer of the company, Donington House, W.C.

Wakefield.—October 15th. One 550-b.h.p. high speed engine and one 400-kw. two-phase alternator. See "Official Notices" September 27th.

Woolwich.—October 15th. "Free" or "assisted" wiring for the Electricity Committee. See "Official Notices" to-day.

Yarmouth.—October 7th. Wiring the new Pavilion for the New Britannia Pier Company. See "Official Notices" to-day.

CLOSED.

Battersea.—The Borough Council have accepted Messrs. Bruce Peebles & Co.'s tender, at £207, for two electric motors.

Blackburn.—Messrs. Dick, Kerr & Co.'s tender for three 850-kw. steam dynamo sets with Belliss engines, has been accepted by the Electricity Committee.

France.—The French Ministry of Posts and Telegraphs has just placed contracts as follows:—Les Forges de Franche-Comté, of Besançon, 35 tons of homogeneous iron wire, 2½ mm. diameter; M. Marcellot, of Eurville, 270 tons ditto, 7 mm. diameter, and 25 tons ditto, 8 mm. diameter.

King's Lynn.—The Corporation has accepted the tender of the British Insulated Wire Company (£412), for the supply of concentric cable, insulated and lead-covered, with earthenware troughing, joint boxes, compound, &c.

Warrington.—The T.C. on Tuesday accepted the tender of the British Thomson-Houston Company for the supply of 8 tramcars for £5,058 15s. The car bodies are to be fitted with Messrs. Milnes' improvements, as introduced into the new Birkenhead cars.

Worcester.—The City Council has accepted the following machinery tenders:—

Boilers, steam pipes, economiser, feed pipes and pumps, Messrs. Babcock and Wilcox, £5,597; boiler setting, addition to tender, £275.
Belliss engines, dynamos, motor-alternator set and booster, Messrs Bruce Peebles & Co., Edinburgh, £9,769.
Condensers, pumps, electric motors, suction, delivery, and exhaust pipes and valves, and tank, Sir Hiram Maxim Company, London, £1,649.
Switchboard, Messrs. Ferranti, Hollinwood, £1,500.
Overhead Travelling Crane, Messrs. Herbert Morris & Bastert, Loughboro', £174.
Accumulators, Messrs. Ashmore, Benson, Pease & Co., Limited, Stockton-on-Tees, £1,317 10s.

The total amounts to £20,281 10s., exclusive of the building (£7,180).

FORTHCOMING EVENTS.

Monday, October 7th.—At 7.30 p.m. Society of Engineers. Ordinary meeting to be held at the Royal United Service Institution, Whitehall.

Friday, October 11th.—Electro-Harmonic Society. Smoking Concert. (See "Notes," p. 552.)

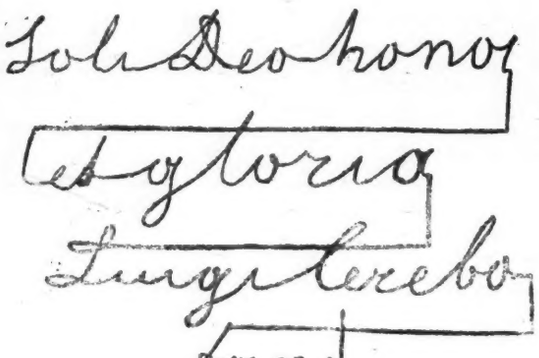
NOTES.

Overhead Wires.—"Overhead" writes to us as follows:—"I have read with much interest the leading article in your issue of September 20th relative to overhead wires, and am especially pleased to note that you call attention to the number of towns in the United Kingdom in which a supply of electricity is provided without statutory powers at all, mostly by overhead wires, and, as you say, apparently without objection on the part of the public. I venture, however, to bring the following incident before your notice as being a matter of public interest, especially in the 26 towns in question. An installation has recently been established at Finchley by the Finchley Electric Light Company, Limited, on a private estate, and without any special statutory powers. Mains have been laid underground in the private roads of the estate, and wires have been taken overhead across roads under the jurisdiction of the District Council to supply consumers outside the estate, the said overhead wires being at a height exceeding 30 ft. above the road at their lowest point. The District Council have all along evinced considerable opposition to the operations of the company, and matters have culminated in the Council cutting the wires of the company which were across one of their roads, and serving a notice that they will forthwith sever any more wires that are erected across any roads under their jurisdiction. The question that naturally arises is, On what grounds can the District Council defend such action, considering that the wires are at a height exceeding 30 ft., and therefore cannot be said to interfere with free passage over the highway? I understand that some reference was made in their notice to the Electric Lighting Act of 1882, but one can hardly think that they are relying on that Act, as the provision of the Act appears to be applicable only to 'undertakers' within the meaning of the Act, namely, local authorities, companies, or persons acting by virtue of special statutory powers. At any rate, the matter seems to be one of some importance; if the Finchley District Council are within their rights in thus acting, it is open for any District Council to do the same in any of the 26 towns in question. The matter therefore is one that ought to be thoroughly thrashed out, and it will be interesting to know what will be the result of their action, what course the Finchley Company will adopt, and what light can be thrown on the matter."

We shall be glad to receive communications from any others among our readers who are practically interested in this very pressing question.

The Electro-Harmonic Society.—The sixteenth season of these concerts, so popular among electrical engineers and others connected with the industry, especially in the London district, commences on Friday next, Oct. 11. The opening concert will be a "Smoker," and the place of meeting the Banqueting Hall at the St. James's Restaurant. There is an excellent programme, both of vocal and instrumental music, including an orchestra, which is always an attractive feature. Now that the foreign tours, congresses, and holidays have been worked off, there seems to be every prospect of a large gathering. We are glad to note that Mr. Lane, the hon. secretary, has as many as 35 new nominations for membership, which is a very promising sign. In regard to the details of the programme, these include vocal music by Mr. Harry Stubbs and Mr. Bantock Pierpont; instrumental music by the orchestra; violin solos by Mr. Gatehouse; recitations by Mr. Alexander Watson; sleight of hand and ventriloquism by Mr. John Warren, and humorous sketches by Mr. Tom Clare.

Dr. Cerebotani's Teleautograph.—A few months ago successful experiments were carried out on the telephone line from Munich to Augsburg, in Bavaria, by the General Post Direction in Munich and the Post Office in Augsburg with this teleautograph, as well as with an improved switch system for telephone circuits. Last August the experiments with the teleautograph were again conducted in such a way that both apparatus—transmitter and receiver—were placed in Munich, so that the transmitter was switched in the wire to Augsburg, and the receiver in the continuation of it from Augsburg, in order to cover a distance of about 90 miles. The result of the successful experiment was that the words "Soli Deo honor et gloria, Luigi Cerebotani," were written by the receiving pen at the same time as by



the transmitting pen. Both writings, the one from the transmitter by hand, the other from the receiver by electricity, are exactly the same. The illustration herewith shows the writing as received. We understand that the simplicity of the construction and the certainty of the process are quite remarkable. Both apparatus—transmitter and receiver—are at all times ready without any preparation. As soon as the apparatus is switched in, all that is to be done is to take the pen at the transmitter and either write or sketch. The receiving pen moves simultaneously with the transmitting one. We hope to publish a description of the instruments employed at an early date.

Lectures.—We are asked to draw attention to the short special course of lectures, of which a notice appears in our advertising columns, on "Insulation and Insulating Materials," which will be delivered by Mr. Mervyn O'Gorman, M.I.E.E., at the Technical College, Finsbury, on Thursday evenings. The first of the six lectures will be given on October 10th.

Twelve lectures on "Electro-Chemistry" are to be delivered by Prof. R. A. Lehfeldt at the East London Technical College, commencing October 11th. See "Official Notices" to-day.

Personal.—Mr. F. Shakespeare Hanning has relinquished the post of resident engineer at Chiselhurst, and has gone to Redruth to carry out the construction of the Camborne and Redruth combined lighting and traction scheme for Messrs. Edmundsons, having continued in their employ with this object in view since his return from India. Mr. Hanning has had considerable experience in conduit and overhead tramway work in India and the Straits Settlements, as engineer to the E.C.C., of Wolverhampton, and as consulting engineer to the Madras Electric Tramway Company.

The resignation of Mr. A. J. Fippard as engineer and manager to the Woolwich District Electric Light Company, Limited, having been accepted, the formerly dual position has been divided between two of the present staff of the company, Mr. W. E. Nicoll, secretary, now being manager and secretary, and Mr. T. M. Colson, chief assistant engineer, filling the post of engineer and works manager.

On Wednesday, September 25th, a smoking concert was held by the Glasgow Corporation Telephone Department to celebrate the marriage of Mr. O. H. Ellis, chief assistant engineer. Mr. Ellis was presented with a handsome marble clock, and a solid silver tea service for Mrs. Ellis. There were about 80 present, presided over by Mr. J. L. Chambers, chief engineer. The local staff of the British Insulated Wire Company, who also helped in the evening's entertainment, had previously presented Mr. and Mrs. Ellis with a set of silver dessert knives and forks.

Mr. H. W. Watts, who has left Alderley Edge to take up a resident engineership with the Weybridge Electricity Supply Company, was last week presented with a set of mathematical instruments from the Alderley and Wilmslow electricity works staff. Mr. C. W. Bentley, the newly-appointed engineer and secretary, made the presentation.

At a convocation of the University of Durham, held at the Durham University College of Science, Newcastle, the honorary degree, D.Sc., was conferred upon Mr. Joseph Wilson Swan, F.R.S.

Mr. Justus Eck informs us that he has now both severed his connection with Messrs. Geipel & Lange and transferred his private consulting business, in order to take up the appointment of technical manager and adviser to the Union Electric Company, Limited, of No. 151, Queen Victoria Street, London, E.C., where his work will be mainly to advise as to the practical applications of their electric generators, motors and arc lamps.

Mr. Sidney H. Short, of the English Electric Manufacturing Company, Limited, left on the *Oceanic*, sailing October 2nd for New York, to attend the annual Tramway Convention to be held in that city, commencing October 9th.

Power for Driving Workshops.—Messrs. J. Crighton and W. G. Riddell presented a paper on the electric driving of a machine shop to the Glasgow Congress. It is not a paper that can be well abstracted, and the conclusions are only approximate, because the works were growing. Under the old system of driving, 1 I.H.P. for 3,000 hours cost 165s., and the total horse-power was 165·2, the yearly cost on all power accounts being £1,406 15s. 6d. Under the new system the mean horse-power was 271·3, and it cost £1,178 19s. per 3,000 hours, or only 86·8s. per horse-power. The chips made formerly amounted to 245 tons annually, and 1·61 tons per year were removed for each horse-power at a cost of £5·21 per ton. Under the new system 367 tons were removed, or 1·74 tons per horse-power per year, at a cost of only £2·48 per ton. Part of the extra power was for lighting, and some of the improved output may have been due to better illumination. The improvement in the cost of power was due to the use of one engine instead of several. Judged by results, the new system has clearly justified itself.

Inefficient Telephone Service.—At the Cardiff County Court, a contractor was on Wednesday awarded £5 damages and costs against the National Telephone Company because of inefficient service and failure to remedy it.

(*Continued on page* 561.)

ELECTRIC LIGHT AND TRACTION AT CROYDON.

Since we described the electricity works of the Croydon Corporation five years ago,* the undertaking has, as might be expected, gone ahead very rapidly. It will be remembered that the Corporation made an arrangement with the British Thomson-Houston Company to equip the works and be responsible for their operation for five years, the company guaranteeing to pay to the Corporation 3 per cent. on the capital laid out, and such sinking fund as the Corporation might have to provide, not exceeding 3 per cent. on the amount. It was proposed that, with the termination of the five years' period, the contractors' interest in the works should end, the plant becoming the property of the Corporation. The success was, however, so speedy, that the Corporation decided to acquire the undertaking earlier than intended, and by payment of a premium of £1,000 to the contractors the matter was settled in March, 1898.

The principal plant five years ago was: — Three Davey-Paxman "Economic" boilers; three 120-kw. B.T.H.-Belliss steam alternators; Ferranti rectifiers. To these have been added two further boilers of the same type, four water-tube boilers, two 250-kw. B.T.H.-Belliss steam alternators, two 500-kw. ditto, and two 300-kw. direct current sets by the Electric Construction Company, coupled to Belliss engines. The "Economic" boilers are for the steady tramway load, the water-tube boilers being adopted mainly because of their rapid steam-raising quality. The equipment also comprises a steam-driven condensing plant, including a cooling pond and three cooling towers, and two electrically-driven condensing plants.

In 1898, Mr. T. H. Minshall, M.I.E.E., was appointed chief engineer, and under his care the system has developed in a most satisfactory way. The following figures will show exactly the progress made since that date :—

Year ending March 25th.	8-c.p. lamps connected.	No. of consumers.	Total horse-power.	Capital Expenditure.	Units sold.
				£ s. d.	
1898	17,514	212	1,170	43,230 4 2	288,647
1899	31,432	415	1,620	88,560 13 4	451,664
1900	45,122	595	2,420	117,384 19 0	781,291
1901	59,241	793	4,120	*171,291 5 8	1,074,665

* Including traction plant.

For lighting, current is generated at Factory Lane at 2,000 volts, and is transformed down to 200 volts at sub-stations, of which there are 26 in different parts of the town. The outlying districts are fed at 5,000 volts alternating through paper cables laid in troughing, and covered in bitumen. The low pressure mains are Callender's armoured cables laid direct in the ground. The Ferranti rectifiers at the works convert alternating into direct for lighting 62 arcs in the central thoroughfares. The more remote districts are lighted by means of low pressure enclosed arc lamps supplied with alternating current from the same mains as arc used for private lighting, except in Brighton Road, where a high pressure system of enclosed lamps is in use.

The whole of the tramway route is brilliantly illuminated by means of arc lamps, a number of the tramway poles being used for suspending them with a pleasing effect, and some of the outlying districts are lighted with incandescent street lamps.

We need not here enter into details of the early tramway history at Croydon. Suffice to say, that in 1900 the Corporation purchased the lines, decided to equip them with overhead trolley, appointed Mr. E. W. Monkhouse, of Westminster, to act as consultant, and finally leased the undertaking to the British Electric Traction Company upon terms.

Electric Car at Purley Termincs.

The main section from Norbury to the borough boundary at Purley was publicly opened with the customary ceremony on Thursday, 26th ult. Altogether 17½ miles of single track are included in the scheme, 5 miles being double track, and 5½ single, with turn-outs. The contractors for the different sections of the undertaking have been as follows :—

Rails, Fishplates, &c. ...	Walter Scott, Limited, Leeds Steel Works, Leeds.
Points and Crossings ...	Askham Bros. & Wilson, Limited, Sheffield, The Lorain Steel Company, London.
Wood Blocks for Paving	Burt, Boulton & Haywood, Limited, J. B. Lee & Sons, and Millars, Karri & Jarri Forests, Limited.
Overhead Equipment and Bonding.	The British Thomson-Houston Company, Limited.
Feeders and Underground works.	The British Thomson-Houston Company, Limited. (Sub-contractors—Callender's Cable and Construction Company, Limited.)
Car Bodies	The British Thomson-Houston Company, Limited. (Sub-contractors—George F. Milnes & Co., Limited.)
Motor Car Equipments ...	The British Thomson-Houston Company, Limited.
Car Sheds (Builders' work)	James Smith & Sons (Norwood), Limited.
Ironwork	Geo. Sands & Co.

The rails are 7-in. girder, and weigh about 95½ lbs. per yard run; Phœnix joints are used. The track is paved throughout with wood, excepting at George Street Corner, and on one or two of the grades where wood was not con-

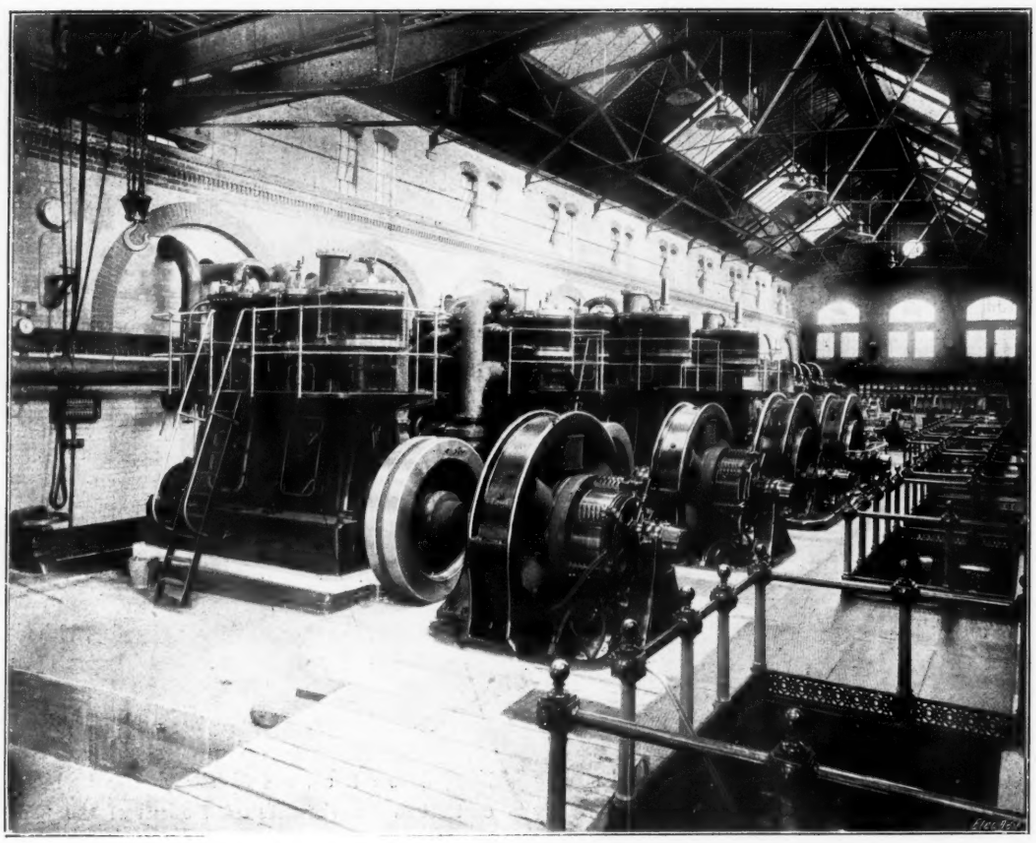
* Electrical Review, November 6th, 1896, p. 598.

sidered suitable; at these points Basaltic lava setts are used, these being less slippery and less noisy than the ordinary granite setts. For the wood paving two sorts of blocks are used, viz., "Jarrah," which is hard wood, and creosoted deal, which is a soft wood. The former is used as an edging along both sides of the rails to reduce the wear, and the latter all over the rest of the surface.

The overhead equipment is on the side bracket system, excepting at certain junctions, where span wires are necessary; special guard wires have been fitted over the trolley wire, so connected that, should a wire fall on to the guard wire and touch the 500-volt trolley wire, an automatic switch at once cuts off the current. A switch also automatically cuts off the current from the trolley wire in the event of breakage.

There are 35 double-decker cars, each accommodating 52 passengers. They have reversed pattern stairways. Each is equipped with two B.T.H. 35-H.P. motors and two brakes (hand-brake and electric emergency). The car shed at Thornton Heath Pond has accommodation for 19 cars, and that at Purley Downs Road for 16 cars. The new Thornton Heath shed will bring the accommodation up to 50 cars. Special stopping places have been arranged for throughout the route; "compulsory" places have a broad white band painted on the poles, "voluntary" stopping places being indicated by a red and white band.

Turning now to the developments which are likely to take place in connection with the lighting and tramway service in the immediate future, in addition to the plant mentioned above, there is also on order a 1,000-H.P. Belliss-E.C.C. engine, combined set, while provision is made for a second one. The traction switchboard, which is placed on the right-hand of the station facing the new traction generators, was provided by the Edwards Electric Company. It is handsomely constructed in black marble, and contains the usual tramway equipment — General Electric circuit breakers, Weston instruments and a Board of Trade panel in the centre, four generator panels on the left, four feeder panels on the right, and also negative feeder and booster panels; there is a separate board controlling the power supply to the various electrical auxiliaries in the works. The lighting switchboard is arranged across the far end of the station overlooking the original lighting plant. Another lighting switchboard is about to be erected, as it is proposed to supply the central portion of the town with direct current in the spring. From time to time fresh districts will be added on to the direct-current area, the alternating current being retained for use in the outlying districts. By these means it is hoped that a very considerable motor load will be obtained in the central parts of the town, especially as the price charged for the latter is a very low one. There are two dryback boilers, supplied by Messrs. Danks, with superheaters now being erected, so that the present station building, when complete, will contain some 8,000 H.P.

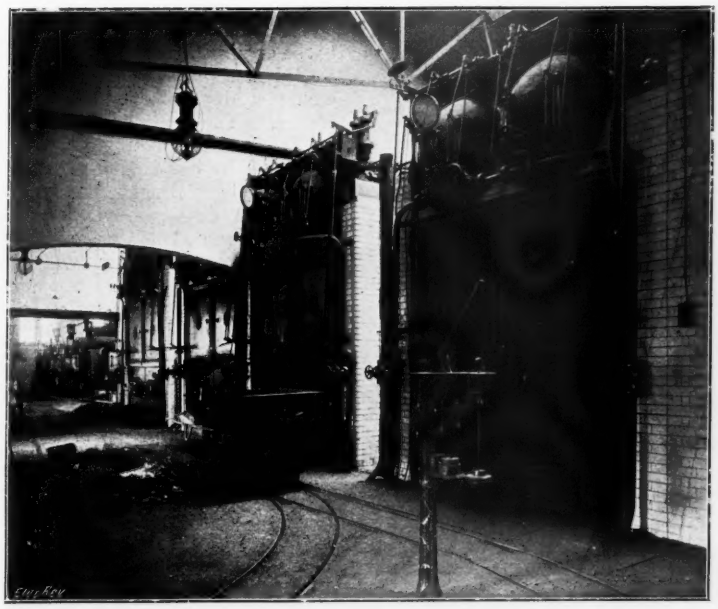


View of Power Station, with E.C.C.-Belliss Traction Sets in Foreground.

Judging from the previous year's results, the cost of production will be a very good testimonial for the high-speed plant.

There are a number of other details connected with the operating of the Croydon electrical system which are distinctly novel, such as the control of the public lighting over an area of 12 square miles by means of a selector system which utilises the pilot wires as well as the telephone wires. By this means the whole of the arc lighting, some 400 lamps, can be switched on or off in a very few minutes from the central station. A vast majority of this lighting is by lamps of the alternating enclosed type, of which the Croydon Corporation were very early users, and, altogether, street lighting is a question which has been very carefully considered, with the result that the road between Streatham and Purley is undoubtedly one of the finest samples of public lighting in the neighbourhood of London. There are 62 Brockie-Pell lamps, the remainder being Lewis's patent parallel and series types, made by the Reason Manufacturing Company. We give in one of our pictures a view along this road

toward the Purley terminus. When the whole arc lighting and tramway system is completed, the total cost per unit will probably be brought down to a much lower figure than has already been obtained, and this in spite of the high price of coal. Mr. F. S. Grogan has recently been appointed resident engineer for the tramways.



Croydon: View of Boilers.

BATTERSEA ELECTRICITY WORKS.

The Vestry of Battersea obtained a provisional order for electric lighting as long ago as 1896; progress, however, was slow, though there were frequent squabbles with the County of London Company, who wished to carry their mains through a small part of the parish to supply their area beyond. Prof. A. B. W. Kennedy was appointed as consulting electrical engineer, and Mr. C. S. Peach as architect; in March, 1899, the scheme drawn up by them was adopted, at an estimated cost of £102,000. Since then the work has steadily but quietly progressed, and the formal inauguration of the installation took place on Saturday last, when the electric light was switched on by Mr. A. M. Torrance, J.P., chairman of the London County Council.

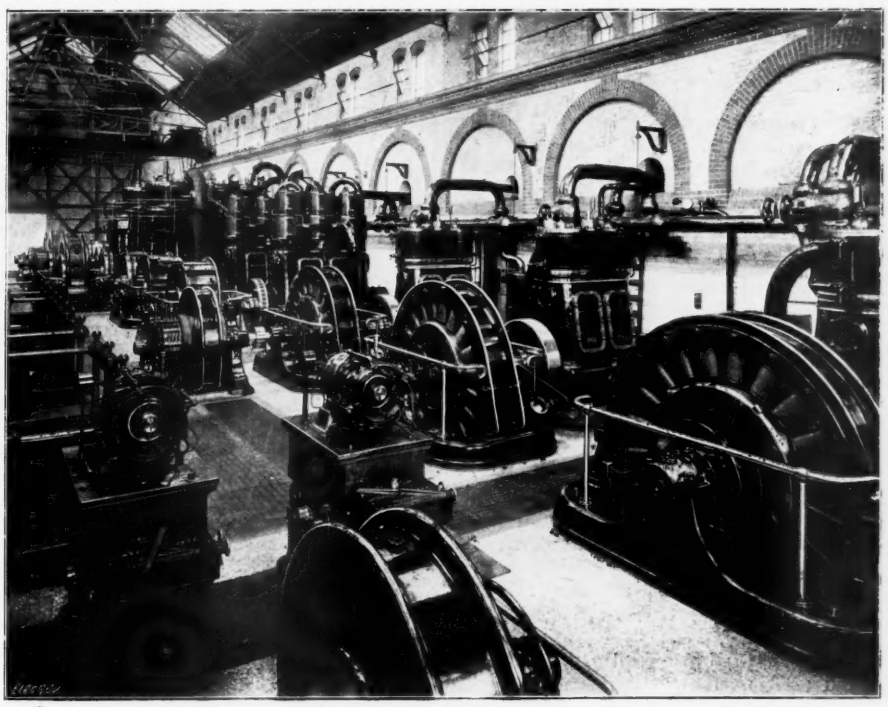
The three-wire direct-current system has been adopted, with a constant pressure of 460 volts across the outer conductors of the mains, and the declared pressure is 230 volts. The mains at present laid are of a section sufficient to supply current to about 60,000 lamps of 8 c.p. connected.

The present installation of plant in the central station is intended to supply about 45,000 lamps of 8 c.p., or their equivalent, with the addition of the street arc lamps, all connected to the mains. This would represent about 17,000 lamps of 8 c.p., and 240 arc lamps in the streets, alight at the same time. The plant for this purpose, including the necessary reserve, amounts to a total of about 1,500 h.p. in boilers, engines, and dynamos. The buildings have been designed so that, when full, they will house plant having a total capacity of about 6,800 h.p.; they are, however, so arranged, that they can be extended with the minimum of expense and trouble, and when the whole of the site has been fully utilised, the buildings will accommodate plant of about 14,000 h.p.

The site, which provides ample room for future extensions, has an area of 47,600 sq. ft., of which at present only some 26,600 sq. ft. has been covered. The buildings comprise the offices connected with the central station, an engine room 90 ft. × 71 ft., a boiler house 123 ft. × 64 ft., coal store, battery room, stores for mains department, and meter testing room.

The chimney, which is a striking feature of the building, is octagonal in shape, measuring 25 ft. 6 in. × 25 ft. 6 in. at the base, and 13 ft. 6 in. × 13 ft. 6 in. at the top; it is 194 ft. high above the ground, and the foundation is 28 ft. below the street level. It is built upon an octagonal block of concrete, 10 ft. thick, 36 ft. 6 in. across, weighing about 100 tons.

The part first built, although a complete building in itself, is so constructed, that it can be extended in whatever way is necessary to meet the future requirements of the borough, and the arrangement admits of the building remaining always complete at each stage of its extension. The buildings are of fire-proof construction, and of a plain, substantial, and durable character. The walls, externally, are



Croydon: View of Station with Original Lighting Plant in Foreground.

faced with picked stock bricks, with blue brick strings and dressings, and the interior of the walls faced with blue bricks, with white and brown glazed bricks in those rooms in which cleanliness and light are of importance. Above the office portion of the buildings apartments are provided for the engineer in charge of the station, and for some of the staff.

Croydon: View of Car at Norbury Terminus.

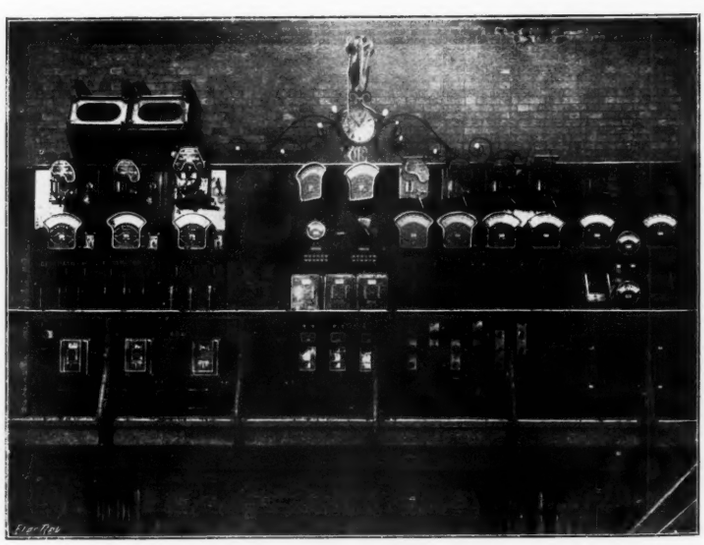
The foundation stone was laid on August 18th, 1900, and those parts of the building occupied by plant used for generating or distributing the electrical current are now practically complete. The offices and rooms for the staff engaged at the station are still somewhat incomplete, owing to the difficulty of erecting those parts of the building which are adjacent to the chimney shaft, until the scaffolding used in constructing it was no longer required, and could be removed. This part of the work is now, however, progressing rapidly, and it is anticipated that the whole of the buildings will be completed by the end of the present year.

Considering that this is the first work of the kind undertaken by the Works Department, it is satisfactory to know that the work performed by every branch of that department was excellent, and has been carried out without a hitch from start to finish.

The boiler house contains at present four water-tube boilers, supplied by Messrs. Babcock & Wilcox, Limited. They are of this firm's well-known type, but are made higher than usual, so as to give the maximum amount of steam for the minimum floor space. Each boiler is designed to evaporate at the normal rate of working 11,000 lbs. of water per hour into steam at 200 lbs. pressure per sq. in., but when necessary, it can be fired at a higher rate, so as to give an evaporation of from 12,000 to 14,000 lbs. per hour. The boilers are fired by Babcock & Wilcox chain-grate stokers, two to each boiler, driven by rods from overhead shafting, the power being supplied by two small engines of 10 H.P., made by Messrs. Reavell & Co., of Ipswich. The products of combustion from each boiler are led into a main flue running underneath the boilers to the chimney placed at the south end of the boiler house. On their way to the chimney the hot gases are passed through a Green's economiser, having 256 tubes. After having had the chill taken off it in an exhaust steam heater referred to below, the feed water for the boilers is pumped through the tubes of the economiser, and is heated to a temperature approaching nearly to the temperature of the water in the boilers.

The steam from the boilers is taken to the engines through a system of lap-welded steel pipes, so arranged as to secure a duplicate supply to each engine. The main steam pipes are 11 in. in internal diameter, and are supported by cast-iron brackets fixed to the walls of the engine and boiler houses. A duplicate system of feed piping is run along the fronts of the boilers. The feed pumps are of the Weir pattern, comprising two pumps, each capable of delivering 5,500 gallons per hour, and a third pump capable of delivering 2,750 gallons per hour, against the full working steam pressure of the boilers. These pumps are placed in a pump room at the base of the chimney shaft, at the south end of the boiler house. The suction pipes for the pumps are provided in duplicate, one suction leading direct from the condenser tank over the pump room, and the other suction being connected to the hot well in the economiser room. This hot well receives the slightly heated water from the exhaust steam heater, the latter being supplied from the feed tank. The pumps force the feed-water either direct into the boilers, or through the economiser and thence into the boilers, as may be desired. The mud drums of the boilers are connected through valves to the main blow-off pipe running along the back of the boilers and discharging into a blow-off tank placed outside the west wall of the boiler house. From this tank the water blown from the boilers is discharged through a pipe running under Lombard Road into the river.

Above the boilers a coal store has been constructed, which is capable of holding about 1,000 tons of coal. The coal from this store will, in the future, be fed into the hoppers of the mechanical stokers on the boilers by means of shoots controlled from the boiler house floor. The coal will first be allowed to fall into a measuring box, the number of times this box is filled being registered on a counter fixed to one of its sides. From the lower mouth of the box the coal will fall through the shoots into the hopper of the mechanical

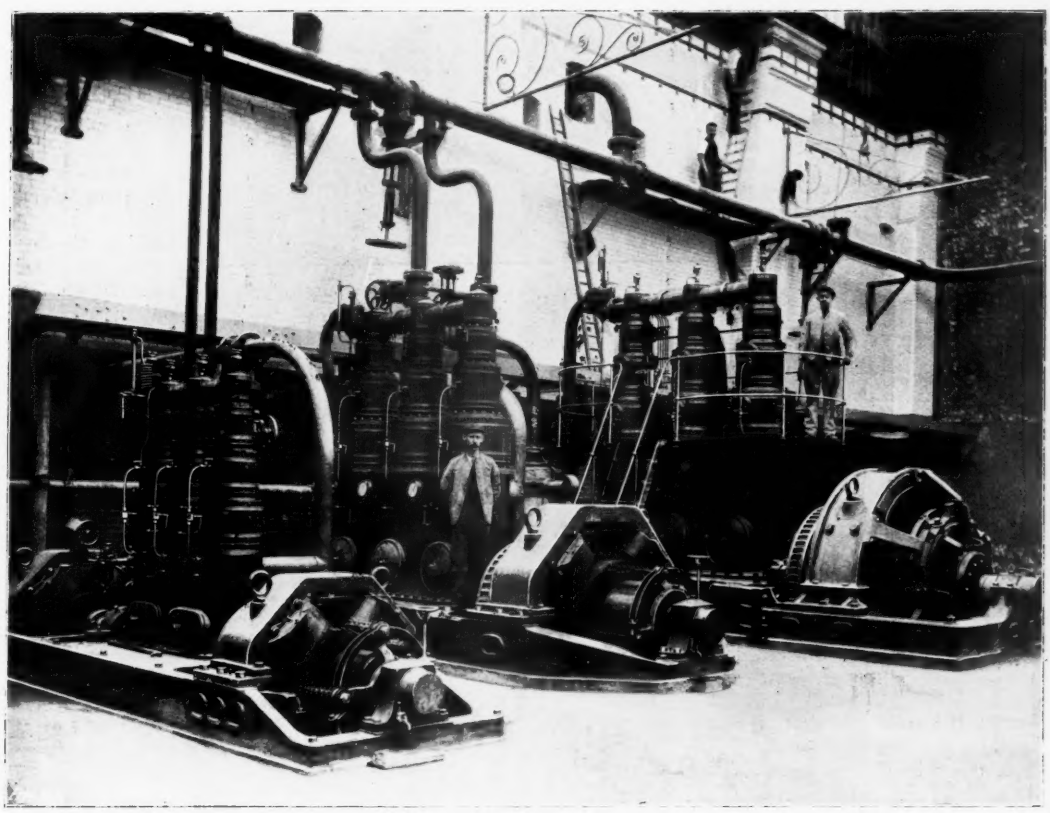


Croydon: Traction Switchboard.

stoker, from whence it will be fed direct on to the boiler grate.

The engine house is adjacent to the boiler house, and is a well-lighted and lofty building. At the south end is the main switchboard, placed on a gallery 12 ft. 6 in. above the engine house floor. From this gallery other galleries run along either side of the engine house, giving access to the platforms of the engines and to the handwheels of the valves on the main steam pipes. The plant at present in the engine house consists of two balancing sets, each with two dynamos, and three main sets. Each of the balancer engines develops 150 I.H.P., and each of the two dynamos driven by the one engine has an output of 46 KW. The dynamos can be adjusted to give this output at any voltage between 230 and 280, when running at the normal speed of 460 revolutions per minute. These two sets are placed at the south end of the engine house, nearest to the switchboard gallery. Next to them are two 360-I.H.P. sets and one set of 575 I.H.P. These are the main steam dynamos, which are connected between the outer conductors of the system. The dynamos exhausting to the atmosphere. The dynamos are of Messrs. Mather & Platt's multipolar type, those on the balancer sets having four poles, and those of the two larger sizes four poles and six poles respectively. The armature windings are embedded in slots round the periphery of the laminated iron core. The current is collected from the commutator by carbon brushes fixed in special holders, attached to a rotating ring by means of which the position of the brushes can be adjusted. From the brushes the current generated by the dynamos is led to the switchboard by insulated conductors supported in the chases underneath the engine house floor.

The switchboard is provided with all the necessary meters, instruments and switches for measuring the current and pressure, and for distributing the energy through the various feeders into the distributing mains. The arrangement of the switches makes it possible to run all the dynamos in parallel at the same pressure on all the feeders, or when it is necessary part of the plant can be run at one pressure on the short feeders and the remainder at a higher pressure on the longer feeders. By means of pilot wires and

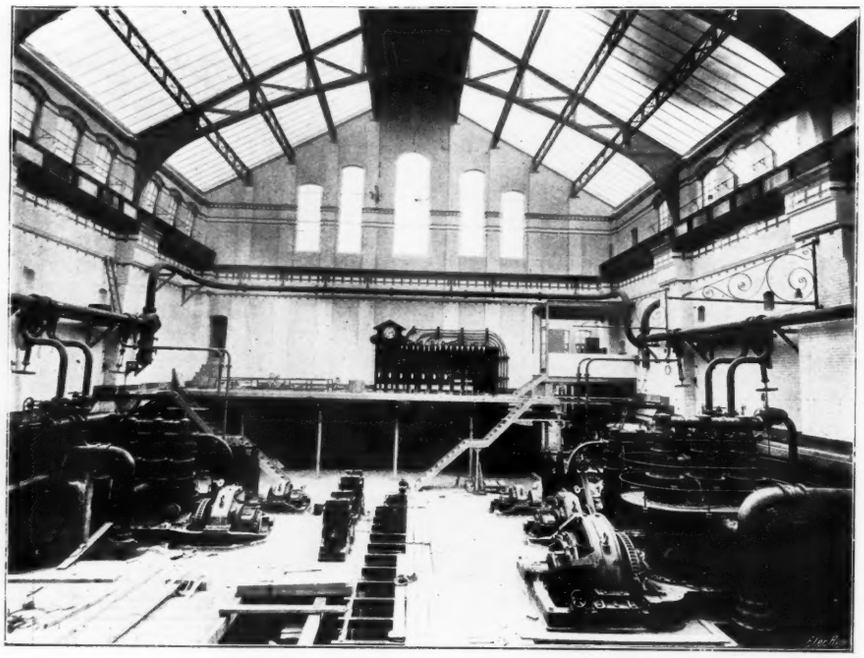


View of Willans-Mather & Platt Steam Dynamos.

of the 360-H.P. sets are designed for an output of 192 KW. at any pressure from 460 to 560 volts, when running at the normal speed of 355 revolutions per minute. The dynamo of the 575-H.P. set is designed for an output of 400 KW., which it will give between the same limits of pressure. Its normal running speed is 325 revolutions per minute.

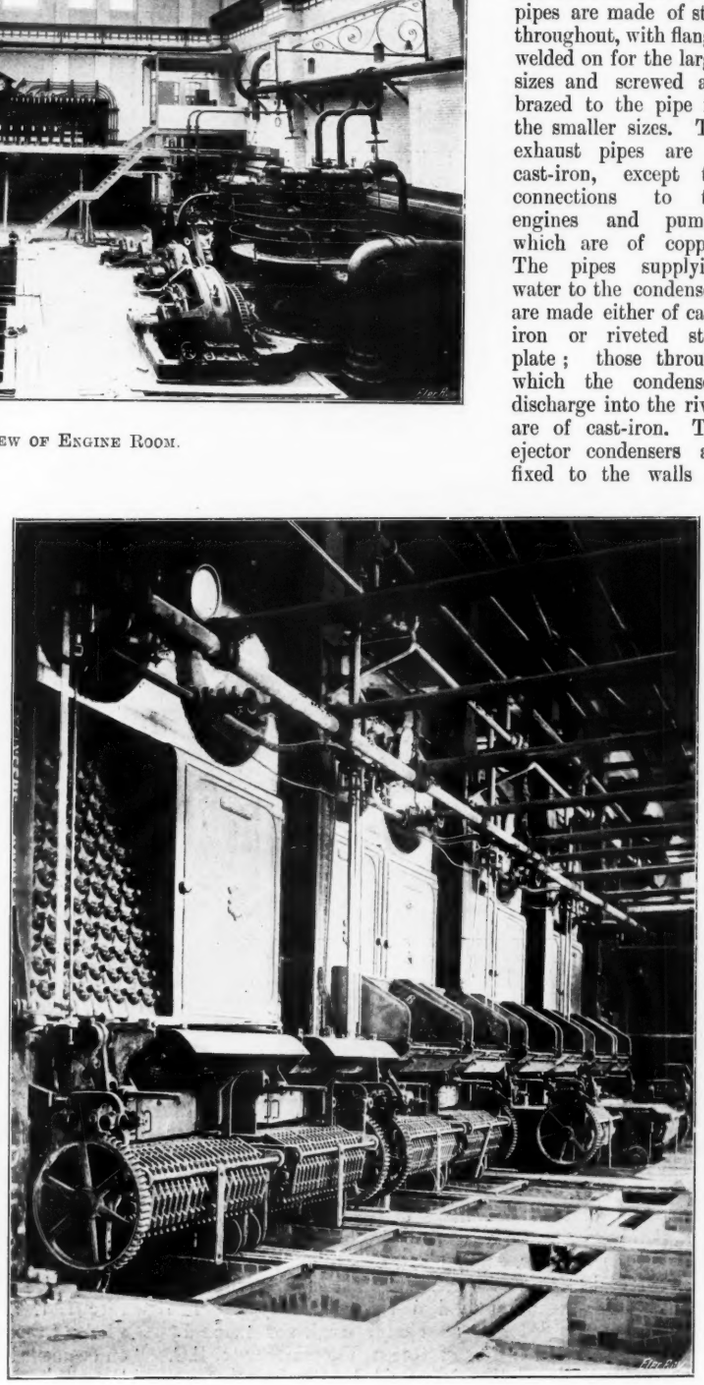
The engines and dynamos have been supplied by Messrs. Mather & Platt, of Salford Iron Works, Manchester. The engines are of Messrs. Willans & Robinson's well known central valve make, the balancer engine being of their 3-G.S. size, and the 360-H.P. engines and the 575-H.P. engine of their 3-P and 3-R sizes respectively. The engines are of the vertical triple-expansion tandem three-crank type. The exhaust steam is led into an ejector condenser made by Messrs. T. Ledward & Co., of Queen Victoria Street, E.C. Each engine in the station is provided with its own condenser, but connections are also made to a main cast-iron exhaust pipe, 24-in. in internal diameter, which is led round the side of the engine house and is connected to a vertical pipe running up the centre of the chimney. By this means it is possible to work the engines either condensing or feeder voltmeters the pressure at each of the feeding points can be read at the station. The switchboard is also fitted with the necessary apparatus for controlling two batteries of accumulators. For assisting in the charging and discharging of these batteries, two booster sets, each consisting of a motor coupled to a 20-KW. shunt wound dynamo, have been provided; they are used either to raise the normal switchboard pressure to charge the batteries, or to assist in discharging when the pressure on the battery terminals has dropped below the switchboard pressure. In addition, there is a small milking booster. The three booster sets were made by the Brush Electrical Engineering Company, of Loughboro'. The whole of the apparatus on the main switchboard is mounted on enamelled slate panels attached to angle iron framing, the latter being firmly bolted to the switchboard platform and stayed to the end wall of the engine house. The main dynamo and battery switches are fixed to a low switchboard placed at the back of the main board, the switches being worked by rods attached to levers placed in front of the main switchboard. The integrating meters are fixed on the

engine room wall below the switchboard platform. The shunt switches and resistances for regulating the pressure of the dynamos are placed underneath the front of the switchboard platform, and worked from handwheels fixed on standards placed along the front of the platform. The number of cells of each battery in circuit can be varied within certain limits by switches placed in the battery room, which are worked also from handwheels on standards placed in front of the main switchboard. The present switchboard is only intended to form a portion of the board as it will be finally; for this reason the board has not been placed centrally on the platform, and the clock has been placed over one end, so that when the whole switchboard is completed the clock will be in the centre. The switchboard and boosters were supplied by the Edison and Swan United Electric Light Company, Ltd.



General View of Engine Room.

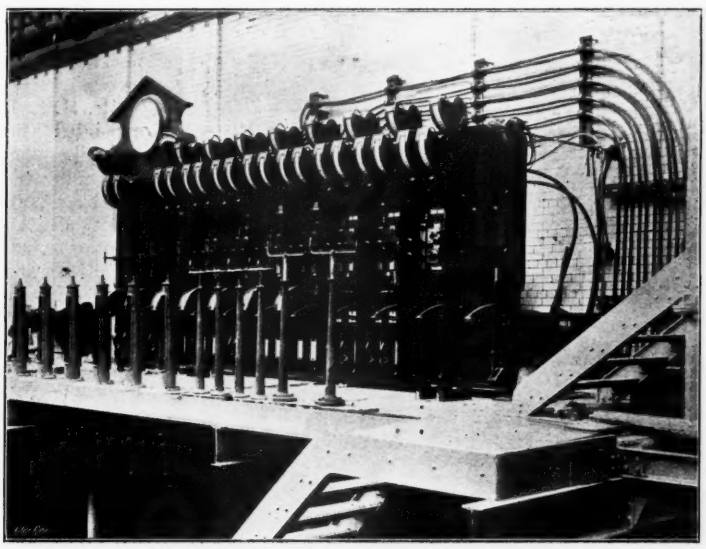
The two batteries of accumulators, one for each side of the system, were supplied by the Hart Accumulator Company, Limited. Each battery consists of 140 cells, and has a total capacity of 1,000 ampere-hours. The steam generating plant will be shut down during times of very light load, and the whole of the energy required will be supplied from the batteries. Each cell of the battery consists of 28 plates immersed in dilute sulphuric acid contained in a lead-lined teak box. The whole of the pipework in the station was supplied by the Sir Hiram Maxim Electrical and Engineering Company, Limited, of Gracechurch Street, E.C. Their contract also included the supply of the feed pumps and economiser, together with a feed heater, cast-iron tanks, condensers, &c. The feed pumps and stoker engines exhaust to atmosphere through the feed heater. By means of a special valve some of the steam from the main exhaust pipe can also be deflected through this heater, which raises the temperature of the feed water slightly before it is pumped through the economiser into the boilers. The heater is placed in the economiser room, which opens direct into the engine room. The whole of the steam and feed water pipes are made of steel throughout, with flanges welded on for the larger sizes and screwed and brazed to the pipe for the smaller sizes. The exhaust pipes are of cast-iron, except the connections to the engines and pumps, which are of copper. The pipes supplying water to the condensers are made either of cast-iron or riveted steel plate; those through which the condensers discharge into the river are of cast-iron. The ejector condensers are fixed to the walls of the engine room adjacent to the engines to which they belong. The circulating water for the condensers will



View of Babcock & Wilcox Boilers.

be pumped from the river into a large tank placed on the east side of the chimney above the meter and economiser rooms, this tank being capable of holding about 15,000 gallons. The water is led from the tank to the condensers by two 20-inch internal diameter riveted steel pipes, from which connections are made to each condenser. All the pipes which have to carry steam or hot feed water are covered with non-conducting cleading made by the Washington Chemical Company, of Washington, County Durham.

The distributing mains are all laid on the solid system. The three cables are laid side by side in a cast-iron trough provided with a covering of hard blue Staffordshire tiles. Wood bridges are placed at intervals as supports, and, after the cables have been laid in position, the trough is filled with molten bitumen and the tile covering laid on. Two sizes of mains have been used; in the large size each of the outer conductors consists of a cable having a sectional area of 0·15 sq. in., while the middle wire cable has a section of 0·08 sq. in.; in the smaller size of main the sectional areas are 0·1 sq. in. and 0·08 sq. in. The cables themselves are insulated with vulcanised bitumen and finally provided with a braided yarn covering. Similar cables for arc lighting of 0·022 sq. in. section are laid in the same trough as the distributors.



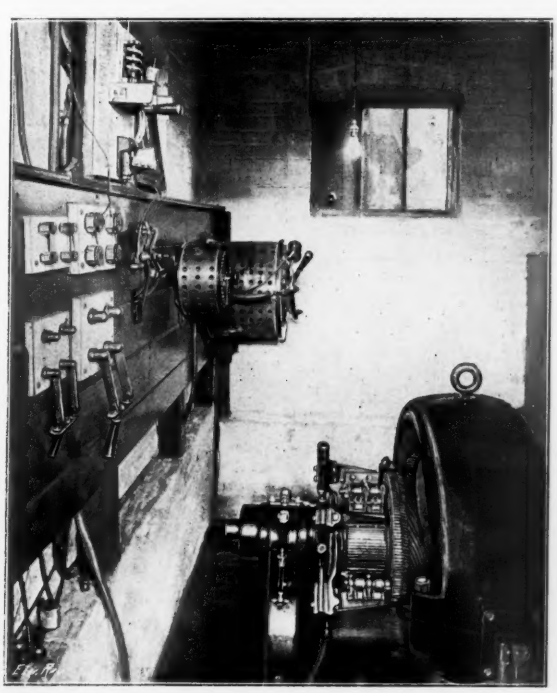
Main Switchboard.

At points where two or more mains meet, and at feeding points, special cast-iron disconnecting boxes are provided, by which any section of main may be entirely cut off and isolated when required. These boxes are placed in brick pits under the pavements, so that they are easily got at by lifting the pavement covers. The service cables to the consumers' premises are also laid on the solid system, the connection to the distributing mains being made in a special cast-iron box fixed in the run of the troughing.

The feeders at present laid are five in number. Each consists of a concentric cable having two cores of 0·5 sq. in. sectional area each. Three of these feeders are laid on the solid system as described above in connection with the distributing mains. The remaining two feeders are provided with steel tape armouring over the insulation, and are laid direct in the ground.

A three-core pilot wire is laid beside each feeder and connected to the distributing mains at the feeding points. A middle wire connection from two points in the distributing network is also brought back to the station; the cables laid for this purpose have sectional areas of 0·25 and 0·5 sq. in. These cables are, of course, only single conductors.

Public Arc Lamps.

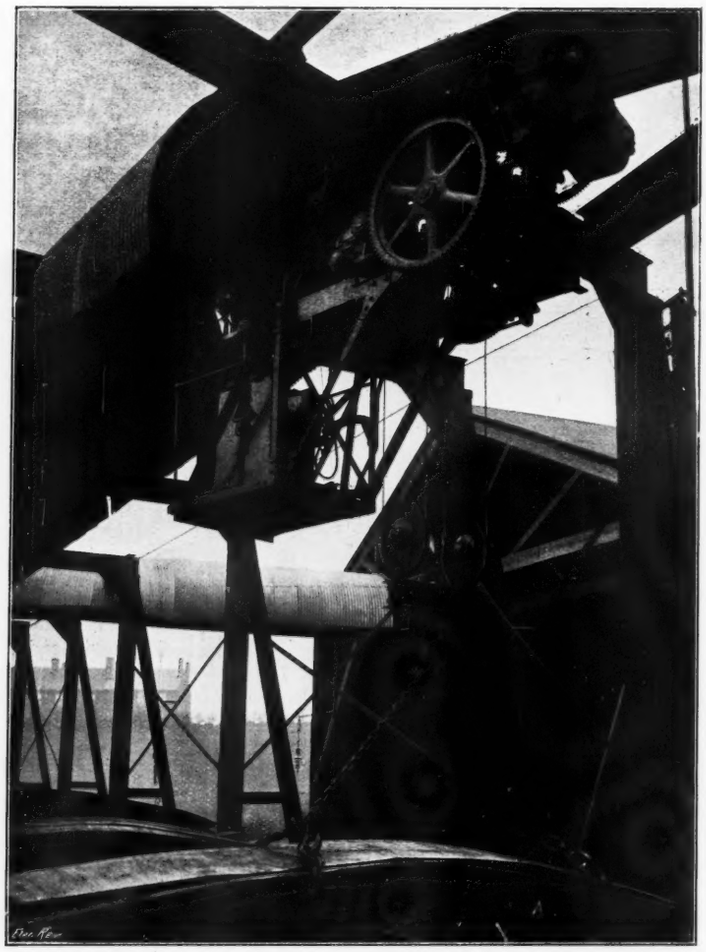


Tube Works: Fig. 1.—Westinghouse Shunt-Wound Motor Driving Shafting.

Each street arc lamp circuit is connected between the "outers" of the distributing mains, in series of 10 lamps. Each series of lamps is controlled by a switch at each end of the circuit, placed in the base of the arc lamp-post.

Stoneware casings have been laid in certain streets in the borough. They form ways into which additional cables can be drawn as required.

The whole of the cables for the mains, feeders, arc lamp circuits and services have been supplied and laid by Callender's Cable and Construction Company, Limited. The



Tube Works: Fig. 2.—Electrically-operated Overhead Single Rail Travelling Crane.

excavation of the trenches and the making good again, as well as the erection of the arc lamp pillars, have been carried out by the works department, under the direction of the borough surveyor.

The arc lamps for street lighting are 240 in number, and have been supplied by the General Electric Company, Limited, of Queen Victoria Street, E.C. They are designed to burn with a current of 10 amperes, and are of 2,000 nominal c.p. each, but the actual amount of light employed in illuminating the roadway is only about half this amount. The lamps are supported on ornamental cast-iron pillars, in most cases being suspended from a bracket, but in a few places they are supported in a central carrier. The design of the pillar, bracket and central carrier is based on that specially prepared some years ago by the School of Art in Edinburgh for the lighting of that city; the same design has since been used in several other places, including Westminster and Carlisle. The whole of the pillars have been supplied by Messrs. J. & A. Law, of Glasgow.

The lamps employed for lighting the engine room are of Messrs. Johnson & Phillips's enclosed long burning "Ark" type.

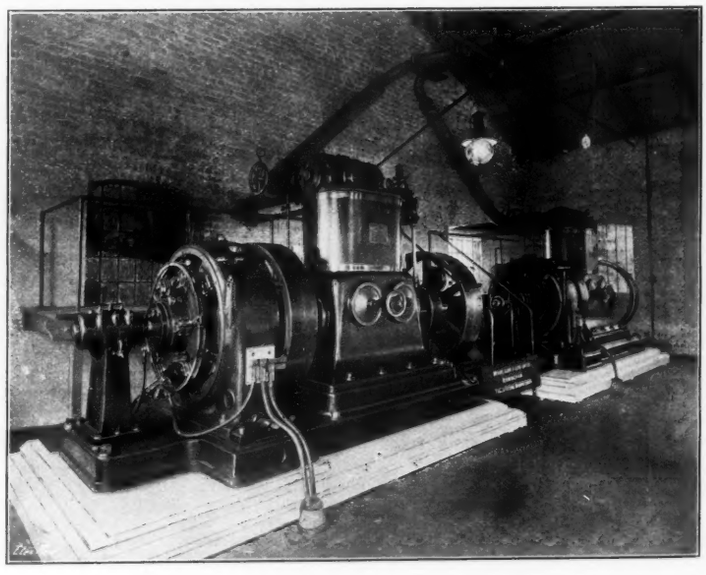
Messrs. Kennedy & Jenkin, as consulting engineers, were responsible for the design of the installation, and were represented on the work by Mr. F. I. Thomas. Mr. C. S. Peach was the architect for the buildings, which were erected by the Council's own workmen, under the direction of the borough surveyor, Mr. J. T. Pilditch.

Mr. H. R. Forbes Mackay has been appointed electrical engineer to the Council.

Opening at the commencement of the busy season, with a considerable street lighting load, the station starts work under the most favourable conditions, and although it would be too optimistic to look for a credit balance in the first year's working, we have no doubt but that the call upon the rates will be of little consequence—an important consideration to all municipalities embarking upon the business of electricity supply, but, above all, to the rulers of that most democratic of metropolitan boroughs, viz, Battersea.

ELECTRIC POWER IN TUBE MANUFACTURING WORKS.

The firm of Messrs. Lloyd & Lloyd, Limited, of Birmingham, is well known as one of the most important engaged in tube manufacture in this country. Originally established in 1859, its business has steadily progressed to the present time. The works at Birmingham, Halesowen and Old Hill (Staffordshire) find employment for several thousands of workpeople. and turn out many miles of tubes of various forms daily. The manufacturing machinery has always been kept well up to date, and the most recent step in advance has been the



Tube Works: Fig. 3.—Two 100-h.p. Westinghouse Generating Sets.

installation of a complete electrical equipment for general power purposes in the Halesowen works.

The generating plant is installed in a separate building located near the centre of the works. There are two generating units, each of 100-H.P. capacity, consisting of Westinghouse combined sets. The engines are of the well-known Westinghouse compound, single-acting, steam type, having cylinders 12 in. and 20 in. in diameter by 12 in. stroke. This type of engine has been on the market for the past 13 years or so, and has been very widely adopted for all purposes where variable loads and long continuous runs prevail, having gained a reputation for exceptionally high economy in operation under these conditions. The crank-shaft of each engine is extended to receive the armature of a Westinghouse compound-wound engine-type generator. This generator yields 75 KW. at a pressure of 250 volts, running at a speed of 300 revolutions per minute. The field of the generator consists of a vertically divided yoke ring, the two halves of which are set on guide plates, with suitable facilities for drawing the two halves apart easily and exposing the entire armature and field windings. The circular field has six internally projecting pole-pieces. These are built up of soft steel laminations cast in the yoke ring. The series coil and the shunt coil of each pole-piece are wound on separate formers, and insulated before being placed in position. The series winding is of copper strip forged into shape and wound edgewise. The armature is built up, together with the commutator, on a single cast-iron spider, the latter being keyed on to the engine shaft extension. The armature core is slotted to receive the coils of the windings. The coils are formed and insulated before being placed in position, which is done without any bending or hammering, and they are secured by hard fibre wedges, driven into small notches in the core slots above the conductors. Binding wires are thus dispensed with, and the whole arrangement is one which conduces to easy repairs or renewals. The commutator is built up on a projecting boss of the cast-iron spider. It is, of course, composed of hard drawn copper segments, insulated by prepared sheets of mica of such corresponding hardness as to yield a very hard and even-wearing surface. This form of construction of the rotating part of the machine secures great rigidity, and should it ever be necessary to remove the armature, this may be done without the necessity of having to disturb the connections between the armature and the commutator. The brush holders are secured to a ring supported by brackets from the field ring casting, thus leaving the outer end of the commutator free for cleaning and inspection. Carbon brushes are used. Each engine and its generator are set on the one bedplate, the total weight of the complete set being about 8,200 lbs. The main switchboards for the control of the generating plant and the outgoing feeder circuits are of the usual Westinghouse construction.

The motors, of which there are at present five installed, are located in small dust-proof chambers, as near the respective centres of the works sections to be driven as possible. Power is transmitted from the motors to the various shafts by machine-cut gearing. The motors, controlling switches, rheostats, cut-outs, &c., are placed alongside the respective motors. All the motors used for the works driving are of the standard Westinghouse multi-polar shunt-wound type, the principles followed in their construction being very similar to those of the generators described (fig. 1). Particular attention is paid to the ventilation of the cores and windings. Cool running is thereby secured, and an unusual capacity for runs at high overloads with perfect safety. The motors include one of 75 H.P. and four of 20 H.P. each. In addition to those installed for operating the various machine tools in the works, there is a dust-proof motor operating a single-rail travelling crane in the yard. This consists of a carriage running overhead, suspended from a single girder rail, and used for conveying material to and from the various parts of the yard and works buildings (fig. 2).

The various processes of manufacture employed in the works include the well-known gas welding process for making large tubes or flues. This was first adopted in these works as the result of costly experiments carried out by Messrs. Lloyd & Lloyd. The Benardos process of electric welding was also introduced here from Russia. The firm is the sole licensee of the patents relating to the latter process, and has developed the details of the method, and granted licenses to many firms during the past 10 years. It is used in the works at Halesowen for the production of large steam tubes for high pressure, and for various other high-pressure fittings. There is also an extensive modern galvanising plant used for the production of high class galvanised tubes. The tubes turned out at these works vary in size from $\frac{1}{8}$th in. up to several feet in diameter, and they are used for every class of work, including gas, steam, air, and water transmission. Special tubes manufactured are :—boiler tubes, gas, water, and steam tubes and fittings, pipe lines for oil, tubular coils for refrigeration or heating, &c.

The policy of this company has always been to ensure the uniform excellence of all work turned out, by the most careful inspection and testing of every product, and also by the employment of the most modern machinery and methods.

NOTES.

(*Continued from page* 552.)

Obituary.—Richard Spelman Culley.—The late Mr. R. S. Culley, whose death took place on September 5th, was born in Norwich in July, 1818. He took a great interest in scientific matters at an early age, but his career may be said to have commenced when he was engaged with the late Sir Morton Peto on the Eastern Counties line, which was built from Norwich southwards towards Ely, and on this line he installed the railway telegraph block instruments (Cooke & Wheatstone's), the earliest actual block system, it is believed, brought into use. Mr. Culley was afterwards associated with Messrs. Cooke & Wheatstone, and in July, 1846, he joined the then Electric and International Telegraph Company (at its incorporation) in Norwich, in charge of the district, of which that town was the headquarters. In 1848 he went to Derby as superintendent, where he married, in 1851, a lady of an old Derby family. In 1851 Mr. Culley was transferred to Manchester, and thence, in 1854, he went to Edinburgh, and afterwards, in 1858, to Bristol. In 1866 Mr. Culley came to London as Engineer to the Electric and International Telegraph Company, and was taken over by the Post Office, at the transfer of the telegraph systems to the State, as Engineer-in-Chief. He met with a severe accident in 1872, when inspecting a new landline between London and Lowestoft, having been thrown from a dogcart in which he was riding with an officer of the Royal Engineers, who were building the line; from the effects of this accident he never recovered, and this led to his retirement late in 1877. On the cessation of his official life he went to live at Weston-super-Mare, where he died, on September 5th. Mr. Culley was a great musician and played proficiently on several different instruments, and latterly on a fine organ which he had installed at his house. He was an insatiable reader of all kinds of literature, both scientific and otherwise. He kept up his interest in scientific matters until the very last, and his mind was as keen as ever until within about three weeks of the end. Mr. Culley was one of the original Council, and a Vice-President, of the Society of Telegraph Engineers, a Member of the Institution of Civil Engineers, of the Royal Society of Edinburgh, and of various other minor societies; he was also a very old Mason. He obtained the Telford Premium of the Institution of Civil Engineers, for his researches in Pneumatic Transmission. His well-known "Handbook of Telegraphy" passed through nine editions, and was translated into most of the European languages; it is still a standard work and of great value. He was the *first* lecturer on telegraphy at the School of Military Engineering at Chatham. As a thorough practical telegraph engineer Mr. Culley made his mark in the telegraphic world, and the British telegraph system of the present day, much as it has altered since Mr. Culley's day, bears the impress of his conscientious and valuable work. Mr. W. R. Culley, his son, is the well-known and able Submarine Superintendent of the Postal Telegraph Department.

Trials of Steam Turbines for Driving Dynamos.—A few weeks ago we published in abstract the paper presented to the recent Glasgow Congress on the above subject by the Hon. C. A. Parsons and Mr. Gerald Stoney. It was shown that a 24-KW. set consumed 28·8 lbs. of steam per KW.-hour at a load of 24·7 KW. with a vacuum of 28·8 in. At 11·8 KW. it consumed 33·9 lbs. with the vacuum at 29 in. When the load was reduced to only 5·15, the consumption went up to 45·6 lbs., not a bad result for so small a load. Without vacuum, however, and with a load of 19·7 KW., the steam consumption was 68·5 lbs. In all cases the pressure was about the same. The lesson is that the turbine should be run condensing. Even an extra 2·8 in. of vacuum at 26 in. gives a better result by 16 per cent. Without superheat a 50-KW. turbine set showed 28 lbs. steam at full load. With superheat of 54° and 64° at pressures of 129 and 134, a pair of 100-KW. machines used 25·5 and 23·8 lbs. of steam per KW. respectively at loads of 123 and 122 KW. Various 500-KW. sets showed an economy of 8 per cent. with 50° of superheat and 12 per cent. with 100°. While we should always expect improvement to come with any degree of superheat, we can quite understand that a steam turbine does not reap the same benefit from superheat as does the reciprocating engine. This is rational, for all parts in a steam turbine are probably near to the same temperature as the steam. The ordinary effects of cylinder condensation do not occur. The benefit which arises from superheat in the turbine may be set down as probably due to reduced friction of the flowing steam. The turbine is theoretically ideal. Its lapse from perfect efficiency is due to internal friction and final velocity of flow. The authors find that the steam consumption curve is a straight-line curve, being proportional to the load plus a constant for no load consumption. Tables of results are given for the 1,000-KW. sets at Elberfeld. The steam consumption was as little as 18·22 lbs. at 1,172·7 KW. average output with steam at 250° C., which implied 10·2° C. of superheat A gain of 12 per cent. was shown for 55° C. of superheat, and of 4 per cent. for each inch of vacuum. Generally the turbine does not compare so well when non-condensing. We should imagine such to be more especially the case with small loads and intermittent steam flow, for at such times the turbine must be churning air. Undoubtedly the turbine has established itself, and will come more and more into use. It is eminently fitted for high-speed dynamo driving, and it is rational as a means of using a hot gas, a point which no other engine can claim.

Blue Electric Light.—According to the *Medical Press*, very extensive therapeutic effects are to be derived from the use of "blue electric light," and if the favourable experiences recorded by Dr. A. V. Minine in *Vratch* of June 23rd are confirmed by subsequent investigations, a great advance in the art of healing has been made. Dr. Minine has found that while blue light produces an anæmia in the parts exposed to it, white light causes the tissues to be filled with blood. The chief advantage claimed for blue electric light lies in its action on the vaso-motor nerves. A further benefit to be secured by the use of this light is that it has a very marked anæsthetic effect, and Dr. Minine has employed it in the suturing of wounds, instead of cocaine. Burns and scalds heal rapidly and painlessly without any local application being necessary, under the influence of this new method of treatment. It appears that the removal of stitches can be carried out without causing any pain by utilising the action of this light. If a contusion be exposed to the light, the occurrence of ecchymosis, or of a hæmatoma, is thereby prevented.

The Hampstead Electrical Supply Company.—In the Vacation Court on Wednesday, before the Lord Chief Justice, application was made on behalf of a debenture holder for the appointment of a receiver and manager of the Hampstead Electrical Supply Company, Limited. The company appeared and consented, and his Lordship made the order as asked, with leave to act as manager for a period of three months.

The Profitable Utilisation of Blast Furnace Gas.—Mr. Thwaite's recent paper before the Iron and Steel Institute was largely occupied by refuting statements of ignorance. It is an astonishing thing that at this late date there should be engineers, and gas engine makers, too, who think that because blast furnace gas ignites often with difficulty under a steam boiler it must therefore fail in a gas engine. Of course it does not fail in gas engines, simply because these machines work with compressed charges. The gas has a low calorific value, but this fits it for power use because no dilution is required such as is the case with richer gases. Indeed, were the whole gas output of a furnace to be utilised it would help the gas engine, if a slightly better quality of gas were produced, as, with blast furnace gas, an engine hardly does so much work as it can safely do. But there is no question whatever of non-ignition. Mr. Thwaite points out the advantages of gas plant over steam. First the cleaning plant is under no pressure, and will last as long as it is painted. It will never need rejection like a boiler because of weakness. He exposes the fallacy of Mr. Dowson's statement (Vol. cxliv., p. 269, *Proc. Inst. C.E.*, 1901) as to the uselessness of blast furnace gas. Owing to lime dust having so bad an effect on the efficiency of hot blast stoves, and blast furnace gas being charged with that dust, Mr. Thwaite would heat the stoves by means of a specially made producer gas, and use the furnace gas, cooled and cleaned, entirely for power purposes. He would also cool the furnace gas by heating the air before it entered the stoves, so assisting these and saving heat all along the line. Mr. Thwaite gives figures for the power to be derived from a blast furnace under various conditions, and derives therefrom a price for energy of 0·6785d. per KW.-hour at a sub-station 6 miles distant. He thinks it would pay a furnace owner to sell energy at 0·3d. per unit, and points out that the continuous working of a furnace renders it best suited to supply current to processes that are continuous, such as electro-chemical and metallurgical processes. A pioneer installation is already under weigh in Germany, where 1,300 E.H.P. is to be provided to coal mines, 800 E.H.P. for light, 500 E.H.P. for metallurgy, 200 E.H.P. for town lighting, and 1,500 E.H.P. for a special electro-chemical industry. The price per KW.-hour is estimated at 0·3d. Foreign ironmasters pushed hard by bad conditions seek to economise, and so to render the cost of iron production less, but our own ironmasters seem, as a class, content to wallow along in the old groove. The author then gives a list of electro-metallurgical industries waiting for further development. It has been stated on the basis of tests made with furnace gas in gas engines that the fuel put into a blast furnace will give as high a result in power as though the fuel were utilised in the best boilers with the highest class of engine. Beyond this power generation, the pig iron product of the furnace is all extra. In a sense, the pig becomes a bye-product. Were this fact realised, it is possible that the present waste of gas and of coal would be checked, for the iron production of this country is about 9 millions of tons a year, and it must use up about 12 million tons of coal, or even more, to simply smelt it. The subject is one of national importance, but those who should be most interested have appeared to us to exhibit the most astonishing ignorance of the subject, and the discussions we have read that have taken place in certain ironmaking districts would appear to point to a singularly poor knowledge of the simple laws of physics and chemistry.

Water-Power in Italy.—A Milan press correspondent says that the King of Italy will shortly visit Milan in order to inaugurate the hydro-electrical installation which has been built on the Tessin River. The object of the enterprise is to distribute electrical energy for various industries, and for the illumination of the town. The plant has a generating capacity of over 15,000 H.P.

Mr. Carnegie and a Technical College.—The Glasgow and West of Scotland Technical College building fund (£150,000 wanted), having reached something over £100,000, Mr. Carnegie has offered to give one half of the deficiency, upon condition that the other half is promptly subscribed.

German Depression.—The Berlin correspondent of the *Financial News* says that the annual reports of a large number of industrial establishments, recently published, show the disastrous effects of the general depression. The Witten Cast Steel Works distribute a dividend of 12 per cent., against 20 per cent for last year. The shares are now quoted at 144, against 170 12 months ago. The ironworks at Menden and Schwerte only pay 4 per cent., against 15 per cent. last year, and the quotation has declined from 115 in September of last year to 72. The Eschweiler Ironworks, which last year paid a dividend of 22½ per cent., have passed the dividend this year. An exception is the Wissen Ironworks, paying 15 per cent., against 5 per cent. These works profited by favourable buying of pig-iron. The Schuckert Electrical Works at Nuremburg are inaugurating a policy of concentration. It is reported that their works at Jaice (Bosnia) have been sold, and that their representation in Vienna has been given up. On the other hand, it is said that energetic work is being done at Nuremburg to make good the heavy losses caused by the general situation. Their engineers are preparing an electrical type-setting machine to come out under the name of "Electrotypograph."

The Steel Trade. — Mr. Joseph Lawrence, M.P., speaking on 26th ult. at a meeting of the Newport Chamber of Commerce, said that while he was in America recently Mr. Schwab, the president of the Steel Trust, had told him that they could deliver steel billets in England at $16½ per ton, while the lowest price at which English steelmakers could deliver was $17. The $16½ included $5 for ocean freight, but when they had perfected their transport arrangements the price would be still lower. Mr. Schwab also said that at the Pittsburg Steel Works and elsewhere they paid their men double the wages the same class of men got in England, but the cost of producing was only one-third of what it was here. The cheap cost of transport in America greatly contributed to their growing manufacturing supremacy. Iron ore was carried 156 miles for 53 cents per gross ton, or nearly one-third of a cent, or one-sixth of a penny, per ton per mile, and this rate was very profitable to the railways. The cost of carriage from Pittsburg to New York, 450 miles, was less than from Liverpool to Birmingham, one-fourth of the distance.

Electric Shock Fatalities.—On Monday an electrician named James Gray, in the employ of the Chatham and Rochester Electric Lighting Company, was attending to the wires at one of the sub-stations in High Street, when he accidentally received the full force of the current and was killed on the spot.

At the inquest on Tuesday, it transpired that another man catching hold of Gray to drag him away received an electric shock which rendered him partially unconscious. A verdict of "Accidental death" was returned, the jury expressing the opinion that workmen should wear safety gloves on both hands instead of one hand only.

Mr. Kydd, superintendent of the Auckland (N.Z.) electric light and traction plant, was instantly killed early in September, and it is surmised that electric shock was the cause.

A miner named Moore met his death by electric shock at the Exhall Colliery on the 24th ult. Another man who went to his assistance received a severe shock.

Appointments Vacant.—A resident electrical engineer is wanted for Bootle at £350 per annum. A shift engineer at £150 per annum is required for Manchester, and a junior shift engineer for Perth.

NEW COMPANY REGISTERED.

Veterinary Radiant Heat Syndicate, Limited (71,473).—This company was registered on September 28th, with a capital of £30,000 in £1 shares, to acquire any patents, inventions, concessions, or licences granted thereunder, relating to the application of heat generated by electricity, gas or otherwise, for hygienic or veterinary purposes, to adopt agreements (1) with C. T. Kingsford, and (2) with M. St. Barbe Prichard, and to acquire, establish, and carry on any veterinary, therapeutic, or scientific institution or business. The first subscribers are:—C. Hartley, 43, Friar's Lane, Lincoln, F.R.C.V.S., 100 shares; M. St. B. Prichard, 1—2, Chiswell Street, E.C., Colonial merchant, 100 shares; R. H. Read, Roseville, Richmond Road, Ilford, retired merchant, 100 shares; C. T. Kingsford, 1—2, Chiswell Street, E.C., gentleman, 100 shares; A. Derry, 104, Fifth Avenue, Queen's Park, W., clerk, 1 share; H. T. Winzar, Stoneleigh, Steyning, Sussex, clerk, 1 share; and A. C. Hertel, 24, Connaught Road, Leytonstone, clerk, 1 share. Minimum cash subscription, £100. The number of directors is not to be less than two nor more than five; the first are C. Hartley, R. H. Read, and M. St. B. Prichard; qualification, 100 shares; remuneration, £150 per annum for the chairman and £100 each for the others. Registered office, 3, King Street, Cheapside, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

West African Telegraph Company, Limited (21,626).—This company's annual return was filed on July 19th, when 23,109 shares were taken up out of a nominal capital of £400,000 in 40,000 shares of £10 each, £231,090 has been paid. Mortgages and charges, £139,300.

Calcutta Tramways Company, Limited (14,764).—Particulars of registered mortgages and charges:—Date of covering deed by which the security is created or defined: June 4th, 1901. Total amount secured: £350,000. Date of resolution of directors creating series of debentures: March 20th, 1901. Property charges: The undertaking and property of the company, present and future. Trustees: E. C. Morgan, of 7, Roland Gardens, South Kensington, S.W., and Sir C. E. H. Vincent, K.C.M.G., C.B., M.P., of 1, Grosvenor Square, W. Date of present issue: May 16th, 1901. Amount of present issue: £100,000. Total amount previously issued of same series: £250,000.

Langdon-Davies Electric Motor Company, Limited (55,830).—This company's annual return was filed on August 4th, when 16,100 preference and 49,274 ordinary shares were taken up out of a nominal capital of £70,000 in 20,000 preference and 50,000 ordinary shares of £1 each; £1 has been called up on each of 17,907 shares, and 47,467 are considered as fully paid. No mortgages or charges.

Sunbeam Lamp Company, Limited (25,498).—This company's annual return was filed on August 26th, when 1,765 shares were taken up out of a nominal capital of £25,000 in 2,500 shares of £10 each; £10 has been called up on 908, resulting in the receipt of £9,080. £8,570 considered as paid on 857 shares. Mortgages and charges, £5,150.

SUPPLY STATION ACCOUNTS.

Canterbury Corporation Electricity Accounts.

The possibilities of keeping down costs during the first year of running of a small continuous current station are many. It is only during the second winter that a stable condition is reached, and as last year was the second of operation for the electricity works at Canterbury, we are not surprised to have the figures recording some changes. The capital now spent reaches £36,500, for which 300 kw. of plant have been installed. The revenue has fallen and costs increased, changes which, taken together with larger financial charges, have reduced the net profit to a few pounds. The results are, however, good for a works with just a fifth of a million units output, and the rather altered appearance of the accounts has been beyond the power of the engineer, Mr. Norman Stainland, to prevent.

General Statement.

	1899.	1900.	Increase.
Total capital expenditure ...	£32,454	**£36,521**	£4,067
Number of units sold	152,558	**217,244**	64,691
Number of lamps connected ...	—	**11,588**	—
Total maximum load in kw. ...	161	**233**	72
Gross revenue	£3,169	**£4,034**	£865
Gross expenditure...	£1,256	**£2,148**	£892
Gross profit	£1,913	**£1,886**	—£27
Average price per unit sold ...	4·85d.	**4·33d.**	—·52d

The rates charged are 7d. and 3d. on the demand system, or a uniform figure of 6d. per unit. Roughly three-sevenths of the output was taken by the public lamps, which include 12 10-ampere arcs, 263 columns with three 8-c.p. lamps on each and three columns with three 16-c.p. lamps on each. The revenue has been affected by the low follow-on price, the change being a loss of over ½d. per unit, bringing the average selling price of energy out at 4½d. The output was distributed as follows:—

Year.	Total units generated.	Units sold. Private supply.	Public lighting.	Number of public lamps.
1899 ...	210,188	99,527 (£2,269)	53,086 (£831)	12 arc and 243 incandescent.
1900 ...	321,757	129,613 (£2,691)	87,631 (£1,231)	12 arc & 831 inc't, or equivalent.

REVENUE STATEMENT.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£3,082	4·85d.	**£3,922**	4·33d.	−·52d.
Meter rents	83	·13d.	**96**	·11d.	−·02d.
Supply of lamps	4	·00d.	**16**	·02d.	+·02d.
Sundry fees, &c.	—	—	—	—	—
Gross revenue ...	£3,169	4·98d.	**£4,034**	4·46d.	−·52d.

Coal now reaches nearly $\frac{9}{10}$d. per unit, an increase of $\frac{1}{3}$d. on the preceding year, but this is only in the keeping with analyses of station accounts generally. Repairs and establishment charges show slight rises, but rates have been piled on the works, as the £24 of 1899 have become £184 last year, adding $\frac{1}{8}$d. to the costs. The economical management is attested by falling salaries and wages; these have dropped by nearly $\frac{1}{4}$d. when taken together. Although the total costs are now over 2$\frac{1}{2}$d., the result is still much above the average for small works where over 2$\frac{1}{2}$d. is quite the regular thing.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal	£349	·55d.	£804	**·89d.**	+·34d.
Oil, waste, water, and engine room stores.	17	·03d.	18	**·02d.**	−·01d.
Salaries and wages incurred in generation and distribution and attending public lamps	315	·50d.	366	**·40d.**	−·10d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and renewals of street lamps.	7	·15d.	180	**·20d.**	+·05d.
Works costs	£778	1·23d.	£1,368	**1·51d.**	+·28d.
Rent, rates and taxes ..	24	·04d.	184	**·20d.**	+·16d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	358	·56d.	400	**·44d.**	−·12d.
General establishment charges, stationery and printing, law charges and insurance	96	·15d.	196	**·22d.**	+·07d.
Other expenses	—	—	—	—	—
Total costs ...	£1,256	1·98d.	£2,148	**2·37d.**	+·39d.

The gross profit has fallen £27; financial charges absorbed an extra £365, thus taking up £392 of what in 1899 appeared as net profit; the result has been to reduce the £406 of that year to £14 in 1900.

PROFIT STATEMENT.

	1899.	1900.
Interest on loans, &c.	£674	£882
Sinking fund for repayments	833	990
Net profit carried forward	406	14
Gross profit	£1,913	£1,886

CITY NOTES.

The British Aluminium Company, Limited.

THE shareholders of the British Aluminium Company cannot have enjoyed their sixth annual general meeting which was held on the 25th ult., nor can they, we imagine, have been altogether pacified by the speech in which Mr. R. W. Wallace, K.C., the chairman of the company, moved the adoption of the report and accounts. The amount of aluminium sold during the year was 14 per cent. more than that in 1899, yet the profits were £3,619 less; and this time it has not been possible to pay even an instalment of the overdue dividend on the cumulative preference shares of the company, so that any return upon the ordinary stock seems very doubtful for several years to come. It is, however, only fair to point out that this ordinary stock has never been offered to public subscription; while up to the present the firm has succeeded in paying somewhere about 2$\frac{1}{2}$ or 3 per cent.—we have not the exact figures available at the moment and are quoting from memory—out of the 7 and 6 per cent. due on the preference capital. The directors ascribe the diminution in profit to the increased cost of the coal employed as a source of power in their factories at Larne, where bauxite is purified, and at Greenock, where they make their electrodes; also to the rise in the price of the coke consumed at Foyers in the manufacture of calcium carbide. A loss of £3,143 has been incurred in this latter part of the business owing, the directors say, to delays in the delivery, starting, and working of the new electrical furnaces and plant. This loss is considered to have been "extraordinary," so we gather that the company hopes for a profit in the future. Granting that the new Foyers furnaces are satisfactory and efficient, about which there seems to be a slight doubt, calcium carbide making ought to pay when the business is conducted in a level-headed manner, and not in the fashion adopted on the Continent a few years ago. There are, however, two clouds on the horizon: the lawsuits about the patent rights, and the slow way in which acetylene is attracting the public favour. The logical method of making a carbide factory remunerative is to find more consumers for the gas, and to institute or assist experiments upon the use of carbide in directions other than that of producing light *viâ* acetylene.

In order to strengthen the position of the company, the directors have decided to secure control of the French bauxite deposits at Var, although as we have been repeatedly told, they have their own excellent mines in Antrim. We should like to know whether this is purely a financial move, or whether there is something the matter with Irish bauxite. Mr. Wallace states that he has recently had an opportunity of inspecting the American aluminium factories, and in comparison with them, the works of the British Aluminium Company are of an extremely substantial nature. This is a good fault, and one perhaps common to many British engineering enterprises. So long as the industry does not suffer radical change and the plant become obsolete—of which there seems very little prospect in the case of aluminium—solidity is most desirable, and always pays in the long run by reducing the expense of maintenance and renewal. The only excuse for scamping or unduly economising upon constructional work is that afterwards the owners may have less hesitation in scrapping the whole machinery when something better or some totally different process is invented. The company has succeeded in obtaining Parliamentary assent to the Loch Leven power scheme, which will yield some 18,000 H.P. when it is fully developed as it will be in "three or four years' time." We are not given any hint as to what is to be done with this large amount of energy; probably that question is to be left to solve itself while the civil engineers are at work. At the present moment it does not look as if we could find a market for an additional 18,000 H.P. worth of aluminium or carbide, which would roughly mean either 18,000 tons of carbide, 4,000 tons of aluminium, or a mixture of both; but there are plenty of other things which might be made profitably by electro-chemical or electro-metallurgical treatment. Unfortunately for the proprietors, this new power scheme involves the issue of the remaining 6 per cent. cumulative preference shares of the British Aluminium Company; but that issue, we are informed, has already been arranged for.

Mr. Wallace appears to consider that the action of the Privy Council in refusing the application for a prolongation of Héroult's patent last May was "unfair," unsound as a matter of business, and 'absolutely wrong," "from the point of view of dry legal principle." Mr. Wallace is a lawyer, and is therefore, entitled to his opinion; we should prefer, however, even if we agreed with him—which we do not—to express that opinion in somewhat less "invidious" language. The patent has lapsed beyond recall; and knowing the history of many similar applications for renewal or prolongation in this country, as well as studying the general position of affairs, we cannot see how any other decision could have been reasonably awaited. But we also fail to see that this expiration can do much harm to the British Aluminium Company, for we do not anticipate the formation of any rival manufacturing concern—assuredly the prospects of such an undertaking would be gloomy in the extreme. The French, Swiss, and American works are certainly now free to import metal into England without paying royalty; but (1) the British Aluminium Company has previously stated that the manufacturing costs are lower at Foyers than at Neuhausen, so that the foreigners should not be able to import metal into this country profitably, and (2) a "combine" has been arranged for between the various makers to regulate the price of the metal. The worst of it is that this unsuccessful legal affair will more or less seriously affect the accounts of the British Aluminium Company for the current year, since a large amount of money must have been spent in appearing before the Privy Council to absolutely no purpose.

Still the business would seem to be perfectly sound. The English Government is at last beginning to order aluminium for a great number of different applications—an almost new market for the British firm, though one enjoyed for years by the foreign makers. The whole of the plant is stated to be in good working order, and, except as already mentioned in the carbide branch, there ought to be no more heavy extraordinary expenditure after the present year. The water power is there, has been found to be reliable even in dry summers, and has been judiciously and advantageously "harnessed." Supposing aluminium and carbide do not acquire much greater industrial importance in the future, the directors can always turn their attention to some other branch or branches of the electro-chemical trade. We do not for a moment anticipate any

such necessity; but it is comforting to remember this possible solution of any future difficulty. Aluminium is a valuable metal, although it would appear that some batches of it have not altogether answered expectations based on the examination of other specimens; calcium carbide is steadily winning public favour. It is not likely, nor ever was, that the former would replace every other metal, or acetylene every other form of artificial light; but both, we firmly believe, deserve the success they have already achieved, and with care and attention to small improvements in manufacture as well as to the production of perfectly uniform material, will soon become more important still.

Willans & Robinson, Limited.

Mr. M. Robinson (chairman) presided over the fifteenth half-yearly meeting of the above company, held on Wednesday at the Cannon Street Hotel, and in moving the adopting of the report, said they were able to congratulate themselves again upon a successful half-year. The profit was not quite so large as for the previous half-year, though a little greater than for the corresponding half of 1900. But it had often been pointed out that their system of balancing the accounts half-yearly, instead of yearly, as in so many companies, though an excellent system, had the drawback that each set of accounts covered too short a period for the law of averages to take effect; one is liable to fluctuations from merely accidental causes. For some reason the second half of each year was usually better than the first, and they hoped it would be so this year. The fluctuation was hardly great enough to call for detailed consideration, but one obvious cause was the recent high price of materials. Apart from the profitableness or otherwise of their work, they were of necessity passing through a relatively lean time. The extensions at Rugby were coming gradually into use, but the capital they represented did nothing towards earning the dividend which it now received. They blamed themselves sometimes for the apparent slowness with which the extensions had progressed, but, after all, they had beaten the tool makers; the buildings were ready first, and had they been ready earlier the money paid for them would have drawn still more deeply from the dividend account. At the Queensferry Boiler Works they had had £82,141 invested in buildings, plant, &c., &c., at the end of June, and this was wholly unproductive, and must be so for some time to come. So he thought under the circumstances they might congratulate themselves that they had a 10 per cent. dividend, with the usual large amounts carried to reserve. Referring again to the new boiler works at Queensferry, he knew the great interest which the shareholders took in this enterprise, and that news of its progress was anxiously waited for. Well, the buildings were practically complete except one—the power house—which he must admit was an important one, as it was to produce the electrical and hydraulic power required for working the machinery. The hydraulic presses were for the most part there, and fixed, but they still waited for a good deal of other machinery. One department, however, was complete, viz., the steel making plant, and they were glad to say that the gas producers were actually at work, though at present they were only "baking" the furnaces—that was, bringing them into condition for practical work. They hoped to start steel-making in a week or two. As the object of having their own steelworks was to secure high and special quality of steel as well as certainty of delivery, they did not intend to push on too fast, and there was no reason to doubt that the tube works would be ready to make tubes as soon as a supply of the right material was available. He was sometimes asked if they had orders in hand for boilers to ensure business for the new works. Certainly not, nor did they seek for them. The orders would come fast enough when they could show the world that they could execute them within a short time; two important inquiries even reached them last week. All they had ever said of the Niclausse boiler and its merits, they would repeat now with added force, and they said, further, that the works would be worthy of the boiler. Of the prospects of the latter in the Navy they had spoken in the report. It was useless to say more on the subject at present; it must work out its own conclusion. But let him repeat, as emphatically as ever, that even if the Admiralty failed in the end to acknowledge the enormous advantages of the Niclausse boiler, even if the fanatics who were trying to put back the clock and restore the old shell boilers in the Navy were to succeed, the success of their boiler-making business would still, in their opinion, be assured. They had never even taken the Navy work into account in their calculations, but land work only, for on land the best boiler would win, with little reference to prejudice and with none at all to politics. Of the general progress of the company it was unnecessary to say much. The shops were full of work, and there seemed to be plenty more before them. The authorised issue of capital was carried out with complete success in the spring, though it could not be denied that the time was, and is, an unfavourable one for financial operations. Of the 16,666 ordinary shares of £5 each, issued at £8, 15,436 were taken up at once by the allottees or their nominees. For the balance of 1,230 shares, they had applications amounting to 23,027, and as it was expedient to allot a few for what might be called company reasons, it was not possible to do much to meet their friends' wishes. For the preference shares, issued at £6, the demand was smaller. Of 16,666, 10,087 were taken up. The balance, 6,579 shares, was over-applied for, but not in any very considerable proportion. The share premium had been used to wipe out the goodwill item of £37,879, and the patents accounts of £3,355. They had still to receive about £36,000 in premiums on the late issues, so there would be no difficulty in making the invested reserve fund up to the amount beyond the £100,000, of which they had spoken on former occasions—independent of the debenture redemption fund. This was a result of which a company but eight years old might well be proud. The chairman proceeded to deal in detail with the items in the balance-sheet, and referred to the Volunteer Company of the firm at Rugby, which had been remarkably successful since its formation, and was a movement which he thought would do much good in the works, and help to bind them all together. In conclusion, he dealt with the retirement of Sir Richard Sankey from the board, and the proposed election of Mr. A. Lazenby to the board. The salary proposed to be paid to Mr. Lazenby (£800 to commence with) would be partly made up by the salary at present received by Mr. Lazenby as a servant of the company. It was also proposed to pay Mr. Lazenby 3 per cent. of the profits after 7 per cent. was paid to the shareholders.

Mr. A. R. Holland seconded the adoption of the motion.

Replying to questions, the Chairman said their investments were mostly in Consols. The 3 per cent., suggested by Mr. Lazenby, on the losses of last year's figures would amount to between £600 and £700.

Subsequently, Mr. Lazenby was appointed a director.

Cape Electric Tramways Company.

The report for the year ended June 30th last, to be presented at the meeting on the 16th inst., states that the profit and loss account on the 12 months' working, after provision for debenture interest, shows a net balance to credit of £75,922, which, added to the balance of £11,319 (brought forward from last year), makes a gross total profit of £87,241. From this sum the directors have paid 12 per cent. by two interim dividends. The directors have also placed to the credit of the reserve fund the sum of £8,000, and to the special reserve fund the sum of £12,000, making a total of £20,000 passed to reserve for the year under review. These several sums aggregate a gross total of £70,400, and leave a balance of profit of £16,841, which has been carried forward to next year's account. During the 12 months' working the Cape Town system has carried 13,056,965 passengers, as against 11,332,627 passengers in the preceding year. The Port Elizabeth system has carried 3,253,656 passengers, as against 2,967,426 passengers in the preceding year. The grand total of passengers carried on both systems for the preceding year was 14,300,047. For the year under review the total number is 16,310,621, which shows a satisfactory increase of 2,010,574. After negotiations extending for some years with the Harbour Board, the Cape Government Railway and the municipality of Cape Town, the directors are pleased to announce that at length a joint agreement has been arrived at for the extension of the company's tramway system from the bottom of Adderley Street to the dock gates. A further addition to the Hanover Street line has been constructed during the year under review with most satisfactory results, the traffic on this particular portion of the system having doubled since its completion. The directors, having purchased the suburban railway from Adderley Street to Sea Point (called the "Sea-Point Railway") are now applying for an Act of Parliament to electrify it with a view to establishing an express service to that important suburb. It is hoped that the assent of the Legislature will be obtained at its next session, as the directors anticipate that this line would be an important and profitable adjunct to the Cape Town system. The extension from Port Elizabeth to Humewood, the suburban bathing resort (which was notified as having been sanctioned in last year's report) has been delayed pending the conclusion of a joint arrangement with the Harbour Board of Port Elizabeth and the Municipal Town Council. The directors are now pleased to report that all difficulties have been overcome, and that an agreement has been concluded, as the result of which the construction of this extension will be proceeded with at once. In November last the directors decided to authorise an increase of the ordinary share capital of the company by 100,000 additional shares, and they issued on January 1st 40,000 shares at a premium of 10s. per share. This issue was made to shareholders *pro rata* to their holding, and was almost all taken up by them, a few shares, together with some fractional parts, being sold later at a higher price. The increased capital has been, and is being, utilised to pay for sundry extensions and increased power plant.

British Aluminium Company.

Mr. R. W. Wallace, K.C., in moving the adoption of the report, at the meeting held at Winchester House on 25th ult., commenced by explaining how the error of £4,620 had occurred in the accounts, and apologising for it. He then went on to state that during the period of the accounts, the price of coal was abnormally high, and at Larne, Greenock and Foyers, in so far as they used coke for the production of carbide of calcium, this high price of coal had a very great effect upon the profits that could be made. It was a matter of very great congratulation that the bulk of their heat was obtained from water power. If the same rise had taken place in water power and they had had to pay for the production of aluminium and carbide by coal instead of by water power, they would have made a very serious loss for the year. With regard to the carbide of calcium account, there had been a loss of £3,143. But there was another question which had materially affected their dividend-earning capacity, and that was that they had a large amount of money invested in things which at the present time were unremunerative. The expenses of administration had been reduced,

They had written off a certain amount for depreciation and increased the amount for repairs and maintenance as far as the plant and works were concerned. Their works were of an extremely substantial nature. He had recently been in America and seen similar works which had been put up there, both as regards water power and its utilisation, and their works were of a far more permanent nature and should require much less to be spent on maintenance and repairs than any works he had seen anywhere else. He had heard gentlemen remark that it was a pity they embarked upon the manufacture of carbide of calcium, but carbide only became a commercial article known to the public in the year 1895. The directors made serious inquiry into the position of the manufacture of carbide of calcium. They sent the managing director and the manager at Foyers to the Continent to find out the best means of making carbide, and they arranged that their managers should carry on the manufacture which had previously been carried on by the Acetylene Illuminating Company. Unfortunately it was difficult to get materials to put up the works, and they only commenced to work late last year. They were not satisfied that the plant put down, at least as far as the furnaces were concerned, was the best for the manufacture of carbide of calcium. They were certainly losing an amount of money which from their investigations they did not expect to lose, and they were working at that now. As soon as they got it right, the accounts of the company will be in a very different position. If the sales of aluminium had been greater, they would have been able to use their water-power, and not require to go into other matters. They had still a great deal of water-power, and it was necessary to look into these new matters, and keep abreast of the times. After a tremendous fight in both the House of Commons and the House of Lords, they were enabled to obtain Parliamentary sanction for carrying out the water-power works at Loch Leven. The British Aluminium Company were first of all partners in the Highland water-power concern, but that scheme embraced certain engineering features which they, as a company, did not agree with at the time. They had taken what they considered to be the only remunerative portion of the scheme, and had got that which would give them some 18,000 H.P.—the best power in the United Kingdom—which will be developed in the course of the next three or four years. With reference to the petition for the prolongation of their patent, that involved a great deal of work. He thought it was a very unfair thing that they did not get that prolongation. The Privy Council did not see their way to give it. It was rather invidious of him, as a barrister, to criticise his legal friends, but he was sorry that they were lacking in knowledge of commercial matters, and looked at the thing from the point of view of dry legal principle. He conceived that even in that they were absolutely wrong, because the whole object of the patent laws was to bring new industries into the country. As the prolongation was not granted, they had to make arrangements with the other producers of aluminium in the world. The American patent existed for some little time longer, and France and America are also protected by protective tariffs, so that the company had to fight in an unfair and unequal position. That was why he went to Var and to America to get good terms for this company. They had had to arrange for the acquisition of a controlling interest in the bauxite deposits in the Var district in the South of France, from which all the other companies at present draw their raw material. They had secured the option, and paid a large sum of money in connection with it. Those Var deposits were most valuable. Referring to the future, he was quite certain that the demand for aluminium would go on increasing. It only increased 14 per cent. last year over the year before, but the Government are at last waking up to the necessity of ordering aluminium.

The report was adopted unanimously after discussion.

The Johnson-Lundell Electric Traction Company.

The second ordinary general meeting of the shareholders of this company was held on Wednesday at the Holborn Restaurant, Mr. Leonard W. Holmes in the chair.

The Chairman said that he did not intend to make the usual explanatory speech, as the directors thought it would be more satisfactory to issue a much fuller report than was usual, laying out the position of the company and its affairs, and giving the reasons why there was no dividend. He would, therefore, formally propose the adoption of the report.

Mr. J. B. Hunter, in seconding the resolution, said that, as one of the board, he must frankly say that he was disappointed that they had not made further progress, and no doubt the shareholders felt the same disappointment. At the same time he could tell them that the chairman and the board had attended very steadily and energetically to the company's business, and that applied also to Mr. Laing, who had, unfortunately, been taken away from them by death. There had been only one interest on the board, and that was the interest of the company, and they had only one object before them, which was to make the company prosperous as quickly as possible. He was a good deal disappointed that they had not made greater progress in that direction, not that he attached any great importance to the fact that there was a deficit in the accounts, because they might expect that in the first year; but he had hoped that they would have made somewhat better progress in placing the company's apparatus and inventions before the public, both at home and abroad, than they had done. However, he felt that although a somewhat longer time had been taken than they expected, still great progress had been made, and he was fully hopeful that when they met next year, they would have a report to present which would possibly be satisfactory to the shareholders.

Mr. Regnard said that, as a shareholder, he must say the results presented to them to-day had not borne out the flattering reports that were published in the prospectus, nor did he see that the company had any prospects. The works that they had, should they get orders, seemed to be quite inadequate to enable the company to carry on a larger business. The directors had managed to get a deficit during the time they had been at work. He was in hopes that the chairman would have told them what the directors were doing. If steps were not taken to improve matters, probably things would go on for the next 12 months in exactly the same way, and if no further information was given, their money would gradually dribble away. It seemed to him that the best thing was to wind up and divide what there was left. During the last 12 or 18 months especially the demand for electric traction must have been something tremendous, and he should say that instead of there being a paucity of orders, manufacturers must have been hard put to it to execute orders, and yet their company had done nothing. He thought the chairman should give them very substantial reasons why something had not been done.

Mr. Henderson said that he sympathised very heartily with what the previous speaker had said, and he was very much disappointed that neither the chairman, nor Mr. Hunter in seconding the adoption of the report, had thought fit to say anything in the way of explanation of the present state of affairs. Anyone who examined the accounts and report must feel that they were very unsatisfactory in the highest degree. He (the speaker) had had an opportunity of conferring with shareholders in Dundee, and they were very much disappointed indeed with the paucity of the information given in the report, as well as the want of progress which had been made by the directors in carrying out the promises in the prospectus. He had been instructed to make certain inquiries, which he trusted the chairman would endeavour to answer. First, he should like to know when Mr. MacKay was appointed to the board. Mr. Laing died some time ago, and it appeared that Mr. MacKay had been elected in his place, and he would be glad to know when that was done, and also whether Mr. MacKay had had information sent him of that fact. Looking at the accounts, he saw that there was nearly £12,000 of calls in arrears. That, he presumed, was up to April 30th last, and he would like to know what progress had been made with the collection of those calls. Then there was the sum of £10,000 paid in advance for calls, and he would like to know whether that money had been paid by outside shareholders or by shareholders who were connected with the promotion of the company. They would also like some information with regard to the sum of £1,526, which was entered on the profit and loss account as directors' fees. Of course they were aware that under the articles the directors were remunerated at the rate of £250 per annum, with an additional £250 for the chairman, and that £1,500 was explained as directors' fees, but what he did not understand was why the directors should be included among the sundry creditors for an additional £1,470. The next question was whether the directors thought it altogether decent that they should accept that large amount, which was five times the total of the year's income of the company, seeing that the total income had been taken to pay for the patent rights without doing anything else. The amount for salaries, £2,419, seemed rather high, and he would like to know what that principally consisted of. He would also like some information as to the amount of £596 for royalties. He thought the shareholders had reason to complain that at the statutory meeting 15 months ago they were led to believe that the company was in a satisfactory position, certainly as regarded the progress that was being made in putting its wares upon the market. Whereas now they were told that, after six months of working, the total income was £596 16s. In view of the fact that the balance-sheet showed an available balance of only £15,000, he would like to know whether the directors saw their way to proceed with the business without making further calls, and would the directors pledge themselves not to make further calls without calling the shareholders together? It seemed to him that the company had been put before the public 12 or 15 months before it should have been floated, and the shareholders had been induced to lend money before there was any possible chance of its being utilised. He would also like to know what share of the profits did the chairman or his firm receive, how much in shares and how much in cash, and what holding they still had in the company.

Mr. Shepperd asked how much of the capital was applied for by the public, and who was to blame for the expense to which the company had been put in re-standardising the whole of their generators to conform with the English requirements. If the fault rested with the board he thought they should return their fees.

Mr. Milburn said he was more concerned as to the future, and he would like the chairman to tell them whether he thought there was sufficient grounds to lead them to look for satisfactory results in the years to come.

The Chairman, in reply to the various questions, said that Mr. MacKay was elected to the board on September 20th. It was their intention not to elect him until that meeting, but they found that technically it was necessary to elect him before, and therefore it had to be done. He was aware that he was to be elected before he sailed for America, and he had an interview with the board upon the subject. As to the calls in arrear, they had hesitated to use legal proceedings against the shareholders who had been so good as to assist in the underwriting when they did not really require the money at the moment, but a month ago they gave notice to those defaulting underwriters that if within 30 days the money was not paid a writ would be issued, and that day they had instructed their solicitors to take proceedings. With regard to the £10,000 which had been mentioned as being expended by the company in payment of calls, that was the transaction that was mentioned in the prospectus, and the shares were held by the Electric Vehicular Syndicate.

On the question of directors' fees, he wished to say that the board had not taken their fees, for if they had they would not appear as creditors. They anticipated that they would be asked to forego what they had hardly earned, but the shareholders must remember the trouble and work which the directors had put into the company; although nothing was shown for it at present, they hoped there would be in the future, and he could assure them that if ever a board earned their fees they had. But they were perfectly willing to forego them for this year. They had done everything possible to make the company a success. It was most unfortunate that they had had to do so much work which they did not anticipate. As to the salaries, they consisted of the sum paid to Mr. Johnson, who when he was in this country had to be paid as the technical engineer, and then there was the office staff and the salaries in the drawing office in America, which was shut up about two months ago. He was glad to say that they saw their way to carry on the business for some time without making any other calls, for they anticipated in a very short time to be able to include at least the sale of the German patents. They had got a firm offer of a very substantial sum for that patent, and after that arrangement was carried out they would be supplied with plenty of money to build works. There had been an enormous amount of money lately expended in building electrical works, which he felt sure would not all be kept going, and he was certain that when the company wanted works it would be able to get them very cheaply. As to the holdings of his firm, he might say that they were by far the biggest shareholders, as they held 6,095 shares, and in the Electric Vehicular Syndicate they held a pretty considerable interest. The public subscribed only about 7 per cent. of the capital. They had never had any reason to doubt the value of the property acquired, but it had been very unfortunate that they had not been able to dispose of the foreign patents sooner. Though the company only meant to do business in England, they had bought the patents of the whole Continent of Europe, and it was their first duty to get rid of those foreign patents so soon as they could get a fair price for them. Personally, he had not the slightest reason to doubt the success of their company. Nothing had shaken his faith in it for a moment. He had been disappointed with others as to the progress which had been made, but there had been good reason for it, and all he could do was to ask the shareholders to give them another year of office. There was a strong feeling on the board that the company should either have works itself, or be allied with some other manufacturing company.

After some further discussion the report was adopted.

The Chloride Electrical Storage Syndicate.

The directors' report for the year ending June 30th, 1901, reads as follows:—

The output of the works has been maintained during the year. Although somewhat better prices have been obtained, the profits have increased to but a small extent, owing to the high price of raw materials. These are, however, now showing a tendency to fall. The negotiations referred to in the last report respecting additional land adjoining the syndicate's property have been concluded, and land has been acquired on long lease, running concurrently with the syndicate's old lease, sufficient to provide for any further extensions that may be necessary for some considerable time to come. The syndicate's exhibit of their battery at the Paris Exhibition, 1900, was awarded the gold medal, the highest class of award made to any storage battery. An agreement has recently been entered into with an eminent firm for the supply of batteries for special purposes which your directors anticipate will lead to a considerable increase in the syndicate's business. Your directors have also secured control of the patent rights protecting an improved method of using storage batteries in connection with central stations for the supply of electrical energy for power and lighting which will greatly increase the efficiency and utility of the batteries so used. The balance-sheet shows a profit for the year of £9,660 17s. 1d. After providing £853 6s. 4d. for debenture interest, and writing off from several accounts £4,555 17s. 8d. (an amount which the directors think necessary), there remains a balance of £4,251 13s. 1d., to which must be added £10,429 4s. 9d., the amount brought forward from last account, less directors' fees, income-tax, and audit fee, amounting to £855 19s., making for disposal a balance of £14,680 17s. 10d. The directors recommend that this balance be carried forward, as the money is needed for the conduct of the business. Further capital is required for the extension of the syndicate's operations and for the release of the profits earned for the payment of dividends, but your directors have not concluded any arrangements, as circumstances have not been favourable for raising additional capital on satisfactory terms. The retiring director is Mr. Edward Hopkinson, D.Sc., who, being eligible, offers himself for re-election. The auditors, Messrs. Parkinson, Mather & Co., chartered accountants, also offer themselves for re-election.

The ordinary general meeting was held at Clifton Junction, near Manchester, on Friday, September 27th, Dr. F. H. Bowman presiding. The report and accounts were adopted. Dr. Edward Hopkinson, the retiring director, was re-elected, as also were Messrs. Parkinson, Mather & Co., the retiring auditors.

We are informed that the Chairman, in proposing the adoption of the report, mentioned that the works had been fully employed during the year, and that had they been larger they could have been kept fully going; and seeing that it was necessary in order to meet the demand for storage batteries, which had really only just begun and was rapidly increasing, that the works should be extended if all the business which could be obtained was to be executed, additional adjoining land had been obtained while it could be, on a 999 years' lease at a very small outlay, so that the works could be increased as might be necessary for years to come. He next alluded to the fact that although the company was making good profits year after year, dividends could not be paid because it was impossible for the directors to deplete the capital that was necessary for keeping the concern in its full efficiency; and the fall in values in industrial concerns, and even the best securities, such as consols, had not made it desirable for the moment to endeavour to raise fresh capital. He foreshadowed a coming reconstruction of the company, and this was more fully gone into by Dr. Edward Hopkinson in seconding the resolution.

Dr. Hopkinson went thoroughly into the accounts before the meeting, and explained that before the present board took over the company a large sum had been paid for patents, which had proved to be not of the value they were supposed to have been of when the company was formed, which value was represented on the credit side of the balance-sheet by upwards of £170,000 and on the other side by paper shares; that he thought it would be of great benefit to the company that the items referred to on both sides should be wiped out one against the other, and some fresh capital introduced, so that the balance sheet could be put upon a businesslike basis, and the annual amounts earned be paid to the shareholders, instead of being as now used to wipe off the old incubus and to provide the necessary working capital. Looking at the year under consideration as a normal one, he thought they could look forward to the continuance of the profits which had been realised in the past, and that they should be in a position to pay a reasonable dividend upon the cash capital of the business, seeing that they had solid assets and a flourishing business.

A Shareholder remarked that it was rather hard on the shareholders that when enough money had been earned to pay an 18 per cent. dividend on the actual cash capital of the company they should go empty away.

Mr. Bannister, one of the directors, pointed out that, holding as he did something like 10,000 shares, it would pay him very well indeed to get a dividend, and that he would like it very much; at the same time, as a trustee of the company, representing the interest of the shareholders, he would not be faithful to that trust if he was party to paying away that money in dividends; and that their faithful businesslike conserving of the profits had been its salvation, there not having been more cash paid actually to the company on which to work than £53,000.

The meeting terminated with votes of thanks to the chairman, directors, manager and staff.

Electric Railway and Tramway Carriage Works, Limited.

The third ordinary general meeting took place at the offices of the company at Preston on Thursday last week.

Mr. George Richardson, who presided, in moving the adoption of the report, said that the works were in a good condition, having been fully equipped, and the company had some very satisfactory orders in hand. As regards the past year, the profit had been £21,200, and there had been £3,900 brought forward from the previous year, which made £25,100. Of this the directors recommended that the whole of the expenses referred to in last year's report, amounting to £7,342, should be written off, and that £2,000 should be carried to a general reserve fund. The payment of the dividend at the rate of 8 per cent. took £12,000, and there remained £3,778 to be carried forward. In order to obtain fresh capital, the directors proposed to issue debentures to the amount of £50,000, bearing 5 per cent. interest, the existing shareholders to have the preference in subscribing. Practically, all the money would be employed as working capital.

The report and statements of accounts were adopted. Messrs. Kerr and Fry were re-elected directors, and Messrs. Chiene and Tait (Edinburgh) auditors.

Direct West India Cable Company.

The report adopted at the annual meeting, held at the offices on September 26th, read as follows:

The net result of the year's working (to June 30th, 1901) is a profit of £5,236 10s. 3d., as compared with £5,455 18s. 3d. for the previous year. An interim dividend of 3 per cent. has already been paid, and it is now proposed (after providing £591 2s. for depreciation of spare cable and other stores) to make a further equal payment, free of income-tax, which will leave £2,796 13s. 3d. to be carried forward. This will increase the amount to the credit of revenue account to £27,943 8s. 4d. The company's cables continue to work with complete efficiency. Offers for the sale of debentures to the trustees were invited in December and July last, and £6,695 1s. was paid for £6,700 of debentures, which amount has been written off capital expenditure.

New St. Helens and District Tramways Company.

In the report for the year ending June 30th, 1901, the issue of which has been delayed through negotiations between the company and the Corporation of St. Helens respecting a modification of the terms of the lease, the directors say they regret that the concessions recommended by the electric supply and tramways committee have been rejected by the Town Council. The directors express regret that the accounts do not admit of the payment of the dividend on the preference shares for the six months ending June 30th, 1901. The dividend on these shares is cumulative, and will be paid in full as early as possible. A net profit of £272 17s. 5d. is shown in the accounts after paying the preference dividend and interest on calls paid up in advance to December 31st, 1901. Out of a total of £26,301 2s. 4d. as receipts from traffic, £15,368 7s. 6d. had had to be paid to the Corporation, which was equal to 5·01 per car-mile. Notwithstanding the low fares the tramways have not been used to the extent anticipated. In future substantial reductions would be made in the cost of working by reducing the frequency of the service and in other ways. A steady increase in the traffic receipts is shown. Messrs. J. B. Atherton, J. Atherton and L. Higginbottom, directors, will tender their resignations at the general meeting of the shareholders.

Halifax and Bermudas Cable Company.

The directors' report which was adopted at the annual meeting held on September 26th, reads as follows:—

The net result of working for the year ending June 30th, 1901, is a profit of £4,904 14s. 7d., as compared with £3,795 7s. 9d. for the previous year. An interim dividend of 2½ per cent. has already been paid, and it is now proposed (after providing £258 8s. 6d. for depreciation of spare cable and other stores) to make a further equal payment, free of income-tax, which will leave £2,078 11s. 11d. to be carried forward. This will increase the amount to the credit of revenue account to £15,171 0s. 2d. The company's cable continues to work with complete efficiency. Offers for the sale of debentures to the trustees were invited in December and June last, and £6,298 18s. 7d. was paid for £6,300 of debentures, which amount has been written off capital expenditure.

Prospectus.—The Perth Electric Tramways, Limited, is offering for sale (the list closes to-day, Friday, at 4 p.m.) £150,000 5 per cent. first mortgage debenture stock at 97½ per cent. The prospectus gives details as to the length of track, also the profits upon the last year's working, from which we gather that 12¾ miles are running and are bringing in net profit at the rate of £18,314 per annum; 4½ miles now constructing will, when completed, considerably increase that figure. Messrs. J. G. White & Co., Limited, of College Hill, are the company's engineers. Secretary and offices, E. R. Tasman, 3, Laurence Pountney Hill, E.C.

Brockie-Pell Arc Lamp, Limited.—The report to June 30th shows a net profit of £2,465. Orders are in hand for 800 lamps. The arc lighting at the Glasgow Exhibition has employed a large amount of capital for the time being, and it is impossible to pay a dividend out of the profits, and at the same time to leave sufficient working capital. A call is being made upon shareholders for the balance of capital. The meeting will be held at Worship Street on October 15th.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following to be quoted in the Official List:—London United Tramways, Limited—Further issue of £100,000 4 per cent. first mortgage debenture stock; Willans and Robinson, Limited—Further issue of 10,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 70,001 to 80,000.

Electric Lighting Boards (British Manufacturing Company), Limited.—Sir James Weeks Szlumper, M.Inst.C.E. (Mayor of Richmond), has joined the board of Electric Lighting Boards (British Manufacturing Company), Limited, of which Admiral Sir Henry Nicholson, K.C.B., is acting as chairman for the current year.

Electrical Undertakings, Limited.—The ordinary general meeting of the shareholders of this company was held on Thursday of last week at Winchester House, when the representative of the Electrical Review was informed that the proceedings were strictly private.

Anglo-American Telegraph Company.—The directors have resolved, after placing £6,000 to the credit of the renewal fund, to declare an interim dividend for the quarter ending September 30th, 1901, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock.

Eastern Telegraph Company.—The directors announce the usual interim dividend of 1¼ per cent. on the ordinary stock in respect of profits for the quarter ended June 30th.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending Sept. 27th were £532; corresponding week last year, £456; increase, £126. Total to date, £19,565, corresponding period last year, £17,555; increase, £2,010. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending September 28th were £923; corresponding week last year, £768; increase, £155. Total receipts to date, £17,877; corresponding period last year, £17,663; increase, £214.

Bristol Tramways and Carriage Company.—The receipts for the week ending September 27th were £4,123; corresponding period last year, £3,402; increase, £720.

Central London Railway.—The receipts for the week ending September 28th were £5,902; corresponding week last year, £5,208; increase, £694. Total receipts from July 1st (13 weeks), £73,993. Miles open, 6.

City and South London Railway.—The receipts for the week ending September 29th were £1,938; corresponding week last year, £1,574; increase, £364. Total from July 1st to date, £24,207; corresponding period last year, £19,620; increase, £4,587. Miles open, 4¾.

Dover Corporation Tramways.—The receipts for the week ending September 28th were £268 10s. 4½d.; corresponding week last year, £255 9s. 10d.; increase, £13 0s. 6d. Total to date, £8,669 8s. 4½d.; corresponding period last year, £8,233 12s. 2½d.; increase, £435 16s. 2d. Miles of track open, 2. Car miles run, 1901, 5,335; 1900, 5,161. Number of cars, 1901, 12; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending September 27th were as follows:—D.U.T. Co., electric cars, £3,529 4s. 0d.; D.S.D. Co., electric cars, £803 7s. 1d.; total, £4,332 11s. 1d.; corresponding period last year—D.U.T. Co., electric cars, £3,651 10s. 11d.; ditto, horse cars, £27 3s. 1d.; D.S.D. Co., electric cars, £854 15s. 3d.; total, £4,533 9s. 3d.; decrease, £200 18s. 2d.; aggregate to date, £65,693 0s. 1d.; aggregate to date last year, £64,567 19s. 11d.; increase, £1,125 0s. 2d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and two miles by horses, for the corresponding period last year.

Liverpool Overhead Railway.—The receipts for the week ending Sept. 29th were £1,589; corresponding week last year, £1,685; decrease, £96. Total from July 1st to date, £22,120; corresponding period last year, £20,680; decrease £560. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

A stiffening of the rates in Lombard Street at the end of the penultimate quarter of the year was quickly followed by pronounced ease on the first day of the new month, and investment markets responded sharply to each influence. Consols, forced down to nearly 93, bounded up over ½ per cent. As soon as their settlement was arranged, coincidentally with the cheapening rates for money, other departments followed in the wake of the Funds, and a week that began with melancholy depression looks as though it would end in cheery confidence on Friday night, the eve of another Stock Exchange holiday.

The markets with which we are concerned exhibit little change in either direction, up or down. What falls there are may be ascribed in most instances to the marking of the stocks *ex* dividend, the end of September being a favourite time for payment of interest on pre-ordinary descriptions. The electricity supply section boasts five rises as against a single fall; the telegraph market has one of each, excluding dividend deductions; the railway department shows again a small decline in Central London stocks, and the miscellaneous division is almost featureless. National Telephone shares are attracting considerable attention from speculators, who blow hot and cold in turn upon the terms which the company is supposed to have made with the Government. The new Governmental lines may be expected to commence operations next month, according to the latest pronouncement of St. Martin's-le-Grand. National Telephones have been up to 4⅜ within the week, but are back again to 4. The only noticeable alteration in the prices of the company's issues is a point rise in the 3½ per cent. Debenture stock.

The ceaseless feuds between the Metropolitan and the Metropolitan District Railway Companies have evidently not come to an end with the changes in the directorate. As we mentioned last week, the Stock Exchange is growing utterly sick of the undignified wordy warfare being waged by the companies in the columns of the *Times*. Without venturing in these notes into the arena of the struggle, it may be pointed out that whereas the Ordinary stock of the District amounts to only 2¼ millions sterling, the Metropolitan Consolidated and Surplus Lands stocks come to over 8¼ millions sterling. Or, to put the case yet more strikingly, the market value of the District stock is a paltry £652,500, while the Consolidated stock alone of the Metropolitan Company is worth 4½ millions sterling at to-day's market price. This being so, it is not astonishing that the Metropolitan directors should decline to be rushed into any system of electrification without making every investigation in their power.

A very cordial reception is being accorded to the new Perth (W.A.) Electric Tramways issue of 5 per cent. first mortgage debenture stock at 97½ per cent. Certainly the security appears to be fairly well secured, and although the stock is, of course, far from being gilt-edged, it is quite worth the issue price. Of a very different stamp is the Queensland Government 3 per cent. inscribed stock, now offered at 91½. Of the total amount required, about 1 per cent. is wanted for "electric telegraphs" in the Colony.

Eastern Ordinary is 1 per cent. cheaper on the week, despite the fact that the price now carries 1¼ per cent. dividend, announced in these pages last week. Anglo "A" has recovered a trifle, principally on account of the tremendous excitement over the famous Cup Races, but also on the recovery in Yankee Rails. Moreover, the declaration of the 15s. interim dividend on the Ordinary stock, with £6,000 placed to the renewal fund, has also helped the quotation. Commercial Cable stock is now *ex* a quarterly dividend of 1¾ per cent., but no change has been made in the absurdly wide price, which is considered quite sufficiently good for the Stock Exchange Official List. The company's 4 per cent. Debenture stock, shorn of 2 per cent. dividend, is a point down. Direct West India Cable Debenture remains without change, on the report showing a decline in net profit for the past year of an insignificant £220. Quite a good report is that of the Cape Electric Tramways, showing a net credit balance of about £11,000 more than for the preceding year. The price is steady at £2. Buenos Ayres and Belgrano, at the same price, are ½ better on the week.

We drew attention last week to the quiet buying which was going on in City Electrics, and the price is now 10s. to the good, while the first Debenture stock is also harder. County of Londons have improved in sympathy, but Westminsters at 12 are easier. The market is very quiet, as is the miscellaneous section, too. Telegraph Manufacturing Preference are a fraction down, and New General Tractions are distinctly flat. A preponderance of sellers is invading the market, and neither for the Ordinary nor for the Preference shares is there any support forthcoming.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations Sept. 25th.	Closing Quotation Oct. 2nd.	Business done during week ended Oct. 2nd, 1901. Highest.	Lowest
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	99 —102	...	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	53 — 56	53 — 56	54	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	98 —100	98 —100	99½	98½
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s. %	10¼— 10¾	10½— 11	10 13/16	10⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	5 %	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	100 —102	102	101
16,000	Cuba Telegraph	10	8 %	7 %	...	5 — 6	5 — 6	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	13½— 14½	13½— 14½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4 xd	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —104 %	100 —104 %	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10½— 11½	10½— 11½	...	...
104,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	142 —147	141 —146	143½	142
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	96 — 99	96 — 99	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	115½	114
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14 — 14½	14 — 14½	14½	14⅛
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	114 —119	114 —119	114¼	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	5¼%	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104 %	101 —104 %	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	5½%	11 — 11¼	11 — 11½	11½	11⅛
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¾— 15¼	14¾— 15¼	15¼	14⅞
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	30 — 32	30 — 32	...	...
78,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	41 — 45	41 — 45	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	102 —105	102 —105	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680	1	...	2½%	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝— 1	⅝— 1	...	
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3⅞— 4⅛	3⅞— 4⅛	4¼	3 15/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅜— 5	4⅜— 5	4⅞	4 13/16
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 98	96 — 99	...	...
500,000£	Do. 4 % Deb. Stock-Red.	100	...	...	4 %	95 — 98	95 — 98	96¼	95
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	127 —132	127 —132	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5⅛	5 — 5⅛	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅞— 5⅛	4⅞— 5⅛	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	102 —105	102 —105	103½	...
171,000	West African Telegraph, 5 % Debs.	100	...	...	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14¼— 14⅜	14¼— 14⅜	14 11/16	14⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	103 —106	103 —106	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	¼— ½	¼— ½	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	...	...	...	5 — 6	5 — 6	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	...	...	...	3 — 5	3 — 5	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	101 —104 xd	101 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞— 8¼	7⅞— 8¼	..	...
12,000	Do. do. 7 % Cum. Pref.	5	...	...	...	8¼— 8⅜	8¼— 8⅜	8⅜	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	9⅜	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5¼— 5⅜	5½— 6	...	...
150,000£	Do. do. do. % Deb. Stock Red.	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579	10	6 %	4 %	0 %	8 — 9	8½— 9½	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	11½— 12½	11½— 12½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	121 —126	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8 — 9	8 — 9	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	103 —106	103 —106	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	7 %	5⅜— 6¼	5⅜— 6¼	6	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5¼— 6	5½— 6	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock.	100	...	...	...	104 —107	105 —108	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11 — 12	11 — 12	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	96 —100	96 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13 — 14	13 — 14	...	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	112 —115	112 —115	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	97 —100	97 —100	98¾	97½
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15½— 16½	16⅝	15⅜
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅛	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red.	100	...	...	...	97 —100	97 —100	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2 — 3	2 — 3	...	...
79,900£	Westminster Electric Supply, Ord., 101 to 80,000	5	12 %	13 %	10½%	12 — 13	11¼— 12½	12½	...

* Subject to Founders Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation Sept. 25th.	Closing Quotation Oct. 2nd.	Business done week ended Oct. 2nd, 1901. Highest	Lowest.
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7 — 8	7 — 8	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	89 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	14 — 15	14 — 15	14⅜	14¼
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	11⅜ — 12¼	11⅜ — 12¼	12⅛	12 1/16
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	123 —126	121 —124	123	121½
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	8 — 9	8 — 9	...[a]	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	5½	...
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	...	...	8 %	⅞ — 1	⅞ — 1	...	...
50,000	¶ " " " 6 % Cum. Pref.	£1	...	...	6 %	1⅛ — 1 1/16	1⅛ — 1 1/16 xd	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1½ — 1⅝	1½ — 1⅝	1½	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	99 —102	99 —102	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	15 — 16	15 — 16	15¾	15½
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5⅜ — 6¼	5⅜ — 6¼	...	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	110 —114	110 —114	...	...
1,969,800	Central London Railway, Ord. Stock	Stock	...	...	...	102 — 105	101 — 104	103⅜	103
440,100	Do. do. 4 % Pref. Stock	Stock	...	...	...	105 — 108	104 — 107	...	...
440,100[1]	Do. do. Def. do.	Stock	...	...	...	98 — 101	98 — 101	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1¼%	51 — 54	51 — 54	53	51
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 5½	5 — 5⅛ xd	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	8 %	3¼ — 3⅜	3¼ — 3⅜	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —105	100 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	2½%	¼ — ⅓	¼ — ⅓	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	2½%	1½ — 2½	1½ — 2½	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	80 — 85	80 — 85	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	85 — 90	84 — 89 xd	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅜ — 2¼	1⅜ — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2¼ — 2⅜	2¼ — 3⅛	...	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	98 —102	98 —102	...	...
18,000	General Elec. Co. (1900) 5 % Cum. Pref.	10	...	...	...	9⅜ — 10¼	9⅜ — 10¼	...	...
150,000	Do. do. 4 % Mort. Deb.	Stock	...	...	...	99 — 102	97 —100 xd	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	16½ — 17½	16½ — 17½	17¼	17
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	22 — 23	22 — 23	22 7/16	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	100 —103 xd	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3⅜%	3½%	6⅞ — 7	6⅞ — 7	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	12⅜ — 13	13 — 13½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	38 — 42	38 — 42	38½	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	104 —106	104 —106	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5⅜ — 6¼	5⅜ — 6 xd	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	91 — 94	91 — 94	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 2/—4/-
National Electric Free Wiring, 17/6 paid, ⅛—⅜.
* From Birmingham Share List.
¶ From Manchester Share List.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16.
Do. do. Pref. (£10 pd.), 10⅛—10⅜.
*T. Parker, £10 (fully paid), 16½.

Bank rate of discount 3 per cent. (June 13th, 1901).

MARKET QUOTATIONS, Wednesday, October 2nd.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a " Nitric	per cwt.	22/-	22/-	..
a " Oxalic	per cwt.	32/-	32/-	..
a " Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a " " "	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£15	£15	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a " (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£22	£22	..
a Lead, Nitrate	per ton	£24	£24	..
a " White Sugar	per ton	£31	£31	..
a " Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	3½d.	3½d.	..
a " Caustic (75/80%) ..	per ton	£24	£24	..
a " Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	80/-	80/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a " Recovered	per ton	£5 10	£5 10	..
a " Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a " Crystals	per ton	£8	£8	..
a Bichromate, casks ..	per lb.	2¾d.	2¾d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b " Wire, in ton lots	per ton	£224	£224	..
b " Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c Tube (brazed)	per lb.	10d.	10d.	..
" " (solid drawn) ..	per lb.	8¾d.	8¾d.	..
" Wire, basis	per lb.	7¾d.	7¾d.	..
Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c " " (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£80	£82	£2 dec.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£80	£82	£2 dec.
g " Rod	per ton	£80	£82	£2 dec.
e " (Electrolytic) Bars ..	per ton	£82	£82	..
e " " Sheets ..	per ton	£90	£90	..
e " " Rod ..	per ton	£84	£84	..
e " " H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	8/-	8/-	..
f " Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/5	1/5	..
h Gutta-percha fine	per lb.	6/-	8/-	..
h India-rubber, Para fine	per lb.	3/8½ to 3/9	3/8½ to 3/9	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i " Pig (Cleveland warrants) ..	per ton	45/3½	45/9	5½d. dec.
i " Forgings, according to size	per ton	From £11	From £11	..
i " Scrap, heavy	per ton	50/- to 52/6	50/- to 52/6	..
i " Wire, galvanised No. 8 ..	per ton	£10	£10	..
g Lead, English Ingot	per ton	£12	£12 5 to £12 7 6	5s. to 7s. 6d. dec.
g " " Sheet	per ton	£13 10	£13 5	5s. inc.
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9	£9	..
d Mica (in original cases), small ..	per lb.	8d. to 9d.	8d. to 9d.	..
d " " " medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large ..	per lb.	3/2 to 7/8	3/2 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p " rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p " " strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	From £15 to £40	..
i " " in bars		£58	£58	..
g Tin, block	per ton	£113 to £113 10	£115 10 to £116 10	£2 10 to £3 dec.
g " foil	per lb.	1/6	1/6	..
n " wire, Nos. 1 to 16	per lb.	1/8	1/8	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j " 6 lea. Flax	per lb.	5⅜d.	5⅜d.	..
j " 8 ply 10 lbs. Russian ..	per lb.	4 1/16d.	4 1/16d.	..
j " 10 lbs. Russian, single ..	per lb.	4⅛d.	4⅛d.	..
j " 180 lbs. Jute rove	per ton	£10 7 6	£10 7 6	..
k Zinc, Sh's. (Vielle Montagne ond.)	per ton	£22 10	£22 10	..

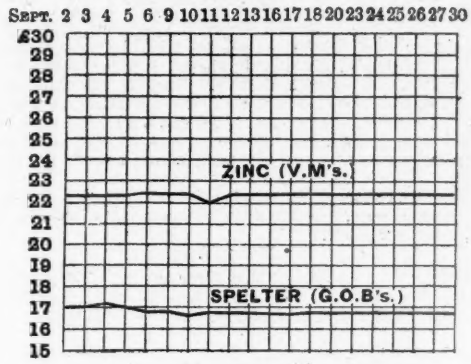
Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. e Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakspeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Rolling & Lowe. j Messrs. Walter H. Hindley & Co.

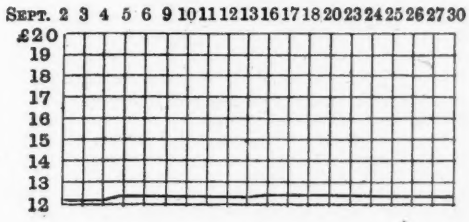
Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

METAL MARKET.

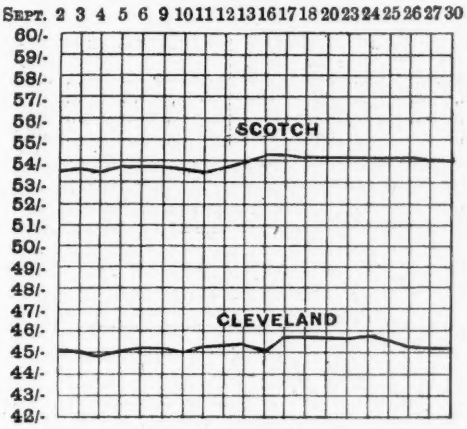
Fluctuations in September.



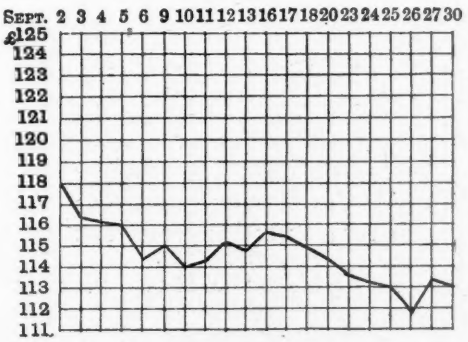
LEAD (ENGLISH).



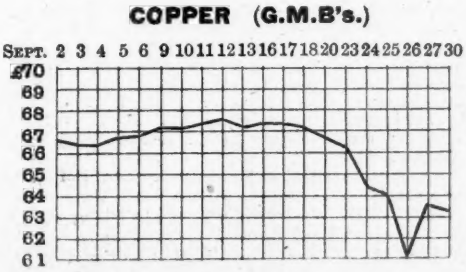
IRON.



TIN.



COPPER (G.M.B's.)



THE INTERNATIONAL ENGINEERING CONGRESS OF 1901.

THE RELATIVE ADVANTAGES OF THREE, TWO, AND SINGLE-PHASE SYSTEMS FOR FEEDING LOW-TENSION NETWORKS.

(Abstract of paper read in Section IX. by

Michael B. Field, M.I.E.E., A.M.Inst.C.E.)

(*Concluded from page* 531.)

The two-phase and single-phase systems require the same weight of copper as long as each phase is supplied through a two-core cable and the systems be unearthed; the two-phase system with a three-conductor cable is much more extravagant in copper than the single-phase, but if we have to provide an earthed sheath, and utilise this as one conductor, the two-phase with two concentric cables requires less copper than the single-phase with one concentric cable, since in the former case the two outers being connected by earth form a common main, and hence their cross-section can be reduced.

Table V.

Type.	Volts per phase.	Current.	Area.	Loss total. Per mile.	Max. possible strain on insulation of system.
Single-phase, two-core, or two separate cables—unearthed system	6,500	154	·3+3=·6	6·3 kw.	6,500
Two-phase, three-conductor, with or without common conductor earthed	4,600	109 109 154	·256 + ·256 + ·362 = ·874	6·3 kw.	6,500
Single-phase, concentric, earthed outer	6,500	154	·3 + ·3 = ·6	6·3 kw.	6,500
Two-phase, 2 concentric earthed outers	6,500	77 77 109	·128 + ·128 + ·181 = ·437	6·3 kw.	6,500

The above table illustrates this, showing how the question of Board of Trade regulations may entirely modify one's views.

Switchboards.—Here alone will a simplification be effected by employing a single-phase circuit. In the Glasgow scheme all switchboards together constituted only about one-fifth of the value of the cable system, so that the saving could not have amounted to much.

Any system which will diminish the overall dimensions of the board *safely* will in that respect have an advantage.

Generators.—I have obtained prices of three-phase and single-phase generators corresponding to the Glasgow 2,500 kw. units. The particulars given to each maker were as follows:—

Output, 2,500 kw.; voltage, 6,500; efficiency full load, 96 per cent.; three-quarter load, 95 per cent.; half load, 93 per cent.; speed, 75 revolutions; cycles, 25.

Fall of pressure between full load and no load, at constant speed and excitation, and power factor unity, to be not more than 7 per cent.

Generator to be supplied without outboard bearing or shaft, but with bedplate, rheostat, &c.

From Table VI. it is evident that the three-phase generator is cheaper and lighter than the single-phase.

Table VI.—Generators to Specifications as Above.

	Three-phase.		Single-phase.	
—	Weight.	Cost.	Weight.	Cost.
(1)	123 tons.	£6,000	184 tons.	£8,900
(2)	120 ,,	£5,400	140 ,,	£6,200
(3)	110 ,,	£4,600	125 ,,	£5,200

While in my opinion a three-phase plant is the best for operating a large tramway system, I am not such an out-and-out advocate of the three-phase principle as to recommend its adoption where the principal load consists of light pure and simple.

The single-phase motor is now a thoroughly practical and fairly economical machine, so much so, in fact, that a very considerable load may be connected to single-phase lighting circuits without detriment (Notes II. and III.).

At the same time, lights may perfectly well be connected to three-phase motor circuits with excellent results. However, the saving of copper in the low tension network where the three-phase system is adopted is practically nil.

Fig. 2 represents a three-phase transmission with three single-phase distribution circuits on the low tension side. The low tension network then exactly corresponds, as regards weight of copper, to a single-phase distribution network.

Now imagine that A and A′, B and B′, C and C′, are grouped together, the area of each of the three mains now being 1·73 times that of A, B, C, A′, B′, C′ taken separately; while we distribute the same amount of power, we reduce our weight of copper 13½ per cent. and lessen the distribution losses by an equal amount. This consideration seems to point to a great advantage in the three-phase distribution; but in the single-phase distribution a three-wire system would certainly be adopted. The corresponding three-wire three-phase system as represented in fig. 3 would, it is true, compare favourably with the single-phase three-wire system; it is, however, an impracticable method, owing to the multiplicity of

Fig. 2.

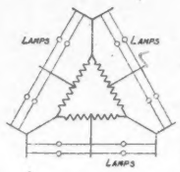


Fig. 3.

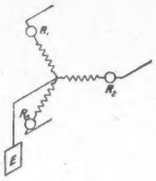


Fig. 4.

inter-connected circuits and the difficulty involved in the independent regulation of the same. The only method which corresponds to the three-wire single-phase is represented in fig. 4, where B_1 B_2, and B_3 are series shunt regulators.

If, then, the lamp voltage across one leg of the system be made equal to the voltage between the outers and the neutral of the single-phase three-wire system, the total weight of copper for a given output and percentage loss will be the same for each. On these grounds I think that the adoption of two-phase plant where the transmission losses are necessarily small, and where both power and light are supplied from the same circuits, is warranted. A further advantage is that it is possible to regulate the phases independently of each other in the generating station, if this be required, with the two-phase system, while with the three-phase system it would be necessary to insert regulators in the low tension mains at the sub-stations (see fig. 5).

The effect on the one phase by the variation of load on the other is, as far as I have been able to ascertain, not materially different with a two-phase or three-phase generator. Roughly speaking, if x % is the drop on a non-inductive full load of a two-phase machine, and one phase be suddenly switched out, the voltage on the other phase will not alter by more than ·7 of x %, or if x be the drop on full load inductive current, the variation will be ·8 of x %.

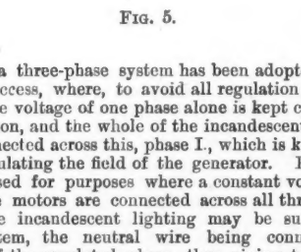


Fig. 5.

In America a three-phase system has been adopted of late with considerable success, where, to avoid all regulation in sub-stations and the like, the voltage of one phase alone is kept constant in the generating station, and the whole of the incandescent lights of the system are connected across this, phase I., which is kept at constant pressure by regulating the field of the generator. Phases II. and III. will be used for purposes where a constant voltage is not an essential, while motors are connected across all three phases. In such a case the incandescent lighting may be supplied from a three-wire system, the neutral wire being connected to the middle point of the regulated phase, thus giving twice the lamp pressure as the working voltage between the motor terminals. When such a system is adopted, no attempt is made to obtain anything like balance of load on the three phases. It appears to me, however, that a two-phase transmission with four-core cables would be just as advantageous.

It is worthy of note that two and three-phase motors and transformers, if connected to circuits of unbalanced load, will tend to draw more load from the unloaded and less from the loaded phases. For instance, if a number of motors be connected to a two-phase circuit supplied from a two-phase generator, and while a number of motors are running one phase circuit be opened at the generator, the motors, while in reality only receiving a single-phase current from that phase still connected to the generator, will apparently run as two-phasers; they will be self-starting, and found to have about ·8 of the normal voltage across the switched-out phase —in fact, the lightly loaded motors will be generating and circulating among the more heavily loaded motors the necessary currents in the switched-out phase, to enable them to work more as two-phase motors than as single phasers.

Note I.

It appears to me that if ever three-phase motors are to be successfully employed for tramway work in crowded cities, the solution of the problem will be found in the combination of two shallow conduits of the slot-rail type with surface contacts; by this I mean such shallow conduits as would avoid contact with underground gas and water mains, but sufficient to afford protection to a number of contact studs laid, let us say, every 2 or 3 feet apart, in the floor of each conduit. These studs would be of the simplest character possible, involving no mechanism whatever, with the exception, say, of every fortieth, which would be of the present automatic surface contact type, and would control the succeeding 39. The automatic switches need not necessarily be placed under the road bed at all, but might be enclosed in boxes under the pavement, or several grouped together and erected in switch pillars and placed at intervals along the route, where their accessibility would be a great point in favour of the scheme. Each car would carry two short skates of, say, 3 feet in length, which could be easily introduced into the conduits at special boxes, and owing to their shortness, would easily ride round curves. Such a system, in my opinion, promises to obviate the dangers of the surface contact, and the difficulty of maintaining good insulation in the conduit system, together with the necessity of removing gas, water, and other mains.

Note II.

In Frankfurt at the present time there are from 500—600 single-phase motors connected to the mains with an average of about 10 H.P. each. The total kilowatts output may be classified as:—

	KW.
Motors	3,427
Motor-generators	1,736
Lighting	6,482
Street ditto	123
In station itself	91
Total	11,859

The variation does not exceed ± 3 volts, the supply voltage being 120, and the frequency 45.

The lamps and motors are all connected to the same machines, feeders, &c. The motor-generators for traction purposes are usually operated separately, *i.e*, from separate machines and separate feeders, but on Sundays the whole load, including traction load, is taken from the same generators, switchboard, and feeders.

Note III.

Table showing comparison of best single-phase motors and three-phase motors of small sizes:—

Power factor single-phase.	Full.	Half.	Power factor three-phase.	Full.	Half.
1 B.H.P.	0·7	0·53	1 B.H.P.	0·8	0·63
5 „	0·75	0·6	5 „	0·84	0·68
10 „	0·8	0·62	10 „	0·85	0·69
20 „	0·8	0·62	20 „	0·87	0·70

Note IV.

Experiments on a three-phase generator loaded on three-phase motor, two phases being loaded on a non-inductive resistance as well. Generator and motor both Y connected; speed and excitation of generator kept constant.

Volts on generator.			Motor load:—Amperes.			Non-inductive load in	
Phase I.	Phase II.	Phase III.	Phase I.	Phase II.	Phase III.	Phases I & II.	
133	132·8	130·5	0	0	0	0	
127·6	126·5	136·1	—	—	—	90	
126·4	126·0	137·0	—	—	—	104	
126·5	126·5	126·0	77·4	78·2	78·2	—	Motor loaded.
124·2	122·5	130·5	28·2	31·8	15·0	91·5	Motor running light.
121·5	122·5	128·5	87·4	70·8	67·8	87·0	Motor loaded.

ELECTRICITY SUPPLY METERS OF THE ELECTROLYTIC TYPE.

(Abstract of Paper read by J. R. Dick, M.I.E.E., before Section IX.).

(*Concluded from page* 533.)

The adjustment of the meter to read in B.O.T. units is an easy matter. The first essential is to obtain a clear reading. A quantity of mercury sufficient to occupy about 1 mm. length of the U-tube gives a quite sensitive enough indication for one unit. The siphon tube, although of very uniform bore, is always calibrated with a moving column of mercury like a thermometer tube, so that each of the divisions exactly equals one unit. The number of grammes of mercury per mm. or per unit can then be calculated from the volume of the tube.

The consideration that determines the amount of the resistance in the main circuit is the all-important one of the permissible drop in pressure. A limit of 1-volt drop at full load has been chosen on 200 to 250-volt supply, this being a convenient figure and one that allows of a fairly large resistance being inserted in the shunt circuit.

The current in the main which will convey a unit per hour is $\frac{1,000}{V}$, where V is the declared pressure. The approximate value of the resistance in the shunt circuit is then found from the following formula derived from the equation $W = C T z$:—Grammes per mm. on scale $= \frac{1,000}{V} \cdot \frac{R}{r} z$, where R is the main and r the shunt resistance, and z is the electro-chemical equivalent in grammes of mercury in the mercurous state. The resistance of the cell is measured by a potentiometer method; knowing this, we can at once find the additional resistance r_1 to be placed in the shunt circuit to equal r.

A final correction in the relative values of the main and shunt resistances is provided for, after they have been checked by a "time" test of the meter, by the following arrangement. The

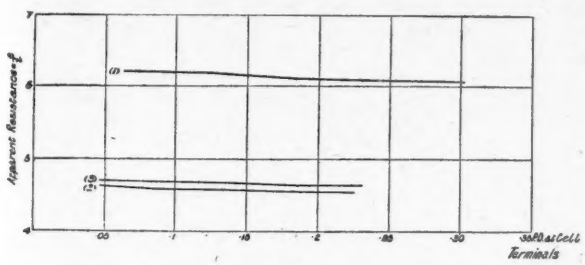


Fig. 6.

platinoid spiral of the former has two straight pieces near its ends which can be slid up or down in two terminals and thus vary its amount. When exact adjustment has been made, the terminal screws can be sealed, and there is no further possibility of altering the resistance or tampering with the meter's registration.

It is amply proved by the behaviour of the meter in practice that its design is successful in overcoming the inaccuracies to which the electrolytic type is liable. Various measurements have been made, however, with a view to checking the theoretical deductions described above, and also to ascertain the lowest current it is possible to register accurately.

The counter E.M.F. is the most important physical quantity in connection with a shunted electrolytic cell. This was determined

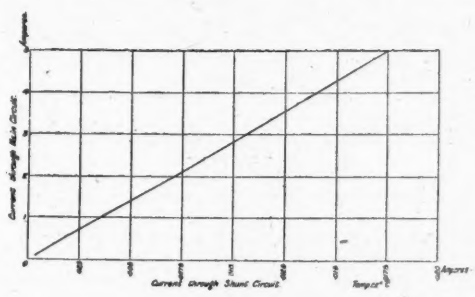


Fig. 7.

very carefully at full load by direct reading, and the mean result of numerous tests on different meters gave a value of ·0001 volt.

The equation for E, the total E.M.F. between the electrodes of an electrolytic cell, has been shown to be—

$$E = R i + \frac{\phi(i)}{i} + e,$$

where e is the counter E.M.F., i the current, R the resistance, and $\phi(i)$ is some function of the current.

Tests were taken to ascertain the importance of the last two factors on three meters, of which the first was freshly made up, the second had its cathode very thinly coated with mercury, and the third had the usual amount of mercury adhering after a long period of working. The curves in fig. 6 are plotted to show the relation between E, the applied E.M.F., and $\frac{E}{i}$, the apparent resistance of the cell.

If the function $\frac{\phi(i)}{i} + e$ were equal to zero and R were constant, the curves would be straight lines parallel to the horizontal axis. The first diverges very little from parallelism, the second less, and the third (or working condition) is, within the limits of experimental error, almost parallel. The small counter E.M.F. in the first two instances may be accounted for by the fact that (according to Oberbeck) when a platinum plate is coated electrolytically with a metal, the electromotive force between it and a solution of that metal only gradually assumes the value observed for the massive metal as the thickness of the deposit grows.

It is extremely satisfactory to note from these tests that there is no counter E.M.F. due to the different degrees of concentration of the solution at the anode and cathode. In other words, the precautions taken to secure good diffusion have fulfilled their purpose. It is an excellent thing to be able to show that the present meter has so many negative virtues. The vital question, however, is this, Does it in practice preserve a constant ratio between the current in the cell and the current to be measured?

Fig. 7 gives the results of experiments on this point. The curve is, within the limits of observation, a perfect straight line passing through the origin, and therefore indicates exact proportionality of the main and shunt currents.

The only extraneous cause of variation the meter is subject to is change of temperature. The electrolyte has a negative coefficient, while the copper wire of the resistance in series with it has a positive coefficient. The combination of the two tendencies in suitable proportions will result in making the total resistance of the shunt circuit constant at all temperatures.

This method of compensation was first made use of by Edison in his zinc electrolytic meter.

The variation of resistance in the cell itself is smaller than that of the copper-wire bobbin, when their resistances are 7 and 40 ohms respectively. Hence, if only copper is used, the diminution in resistance of the electrolyte would be overcompensated for, and the meter would read low at high temperatures; therefore, part

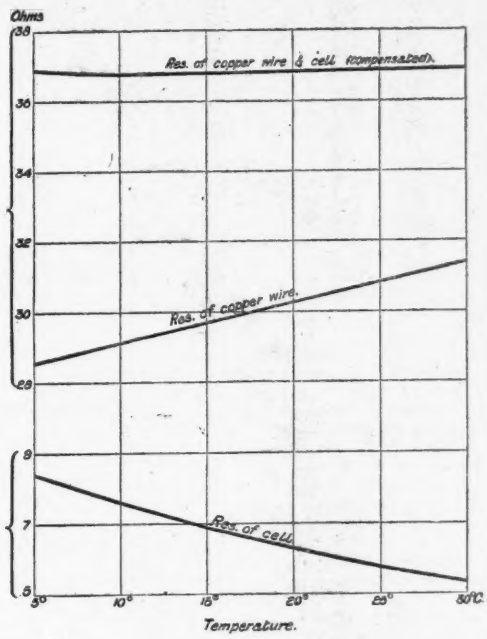


Fig. 8.

of the windings must be of platinoid, or similar material. The curves of a properly compensated meter are exhibited in fig. 8.

A very high degree of accuracy is obtained with this meter, not only with ordinary, but also with extremely small currents. All meters sent out can easily be adjusted to register within 1 per cent. of accuracy.

Perhaps the most remarkable proof of this statement is a series of tests taken on three meters running continuously with 0·05

Fig. 9.

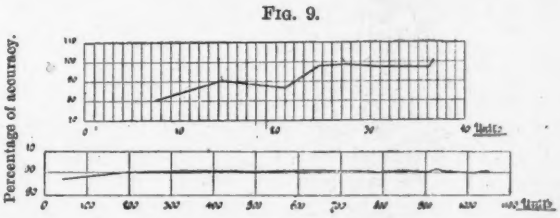


Fig. 10.

ampere. There was no standard meter to test them by at this current, and the units had to be calculated from the current (kept constant) and the time it was on. The duration of these tests had to be as long as four or five months, in order to get any range of reading.

It is noticeable that the error for the first 10 units is considerable. This is due to some of the mercury deposited adhering to the cathode. Ultimately it falls off, and this error practically disappears. Even this temporary error is overcome by the employment of carbon instead of platinum foil.

Fig. 9 gives the graphic results of a record with 0·05 ampere.

When such accuracy can be attained with currents lower than a y used for electric lighting, it does not *a fortiori* appear difficult to

guarantee commercial accuracy within the limit of 1 per cent. stated above.

Fig. 10 represents the curve of an average meter.

Of recent years it has become very generally recognised that some form of maximum demand indicator is a necessary adjunct to a meter, in order to determine a consumer's bill equitably. The additional drop of pressure at the lamps due to this second apparatus is sometimes complained of, although even with a 5-ampere meter it does not exceed 0·6 or 0·7 volt. The electrolytic meter described can readily be combined with a thermal demand indicator in such a way that the heating resistance of the latter serves as a shunting resistance for the former and no further loss of pressure is entailed than with a single instrument.

The total resistance causing the drop of 1 volt, on which the meter

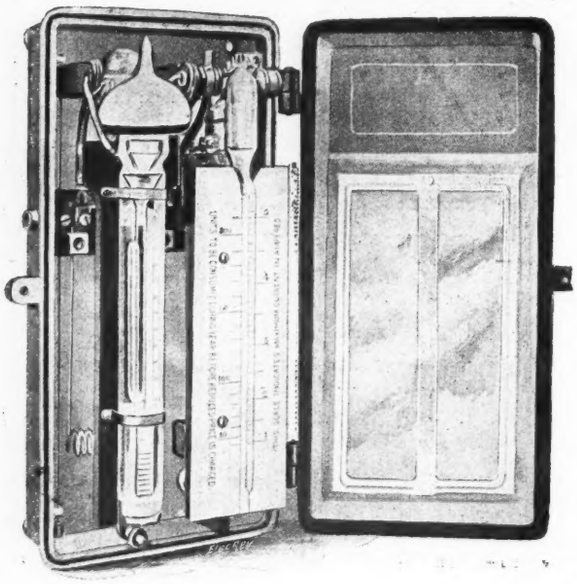


Fig. 11.

proper is calibrated, is made up of the heating coil, together with an adjustable resistance of platinoid wire, in series, similar to that in the ordinary type described above.

A view of the composite apparatus is given in fig. 11.

The diminution of the pressure loss is not the only advantage possessed by this arrangement. It is exceedingly neat, and economises space in a consumer's installation.

In measuring the electricity consumed by an installation on the three-wire system, two meters have to be employed with most of the ampere-hour types. The present meter, however, can be easily adapted for such cases by means of a simple arrangement devised by the author, which answers perfectly for the usual method of wiring houses in England.

The installation is divided into two approximately equal sections, the neutral wire being split for this purpose. At the point of splitting A (fig. 12), two low resistances, R_1 and R_2, are inserted of exactly equal value. The electrolytic cell, with its compensating resistance, is connected across the two further ends (C and D) of these resistances. When R_1 is equal to R_2, the current through the cell will be proportional always to the sum of the currents c_1 and c_2 in the two halves of the installation. For the total difference of potential between C and D is:—

$$c_1 R_1 + c_2 R_2,$$

or, when $R_1 = R_2 = R$,

$$R (c_1 + c_2).$$

Hence the current through the cell, and therefore its readings, will be proportional to the sum of the two currents exactly.

The only extra cost of a three-wire meter is that of an additional terminal and adjustable resistance.

Durability is an attribute of the greatest importance to any apparatus which has to be repaid by a sinking fund during a period of 15 or 20 years.

Provided, as it is, with a strong cast-iron case, this meter can easily stand ordinary external wear and tear. Electrically, its main circuit is very permanent. The platinoid wire, which is not run at a high enough current density to get hot, will practically last for ever, and will not be damaged by a momentary short-circuit.

As nothing is added to or taken from its components during working, and as there is no exposure to the air, the durability of the electrolytic cell depends only on the chemical stability of the mercurous nitrate solution. Fortunately, this is used under precisely the condition requisite for its stability, *i.e.*, in presence of mercury. The chemical analyses made on meters that have been constantly working for eight months, and during that period have registered as many units as they would have done in five years in an ordinary installation, show identically the same proportion of mercurous nitrate in the solution as at first, and only a trace of mercuric nitrate—too small to be measured.

Great care is taken in the manufacture of the meter to use only chemically pure mercury and purified mercurous nitrate solution. If the metal had to be removed and weighed, and fresh electrolyte added periodically, the introduction of impurities, and consequent

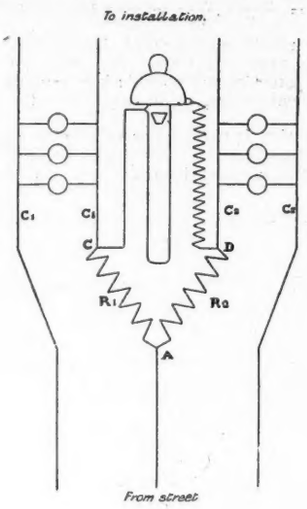


Fig. 12.

errors, could hardly be avoided. In this permanence of the constituent parts, therefore, the successful working of the meter is guaranteed, to all appearance, for an indefinite period without repairs or attention.

In concluding this description of the evolution of a good electrolytic meter, its chief features might be briefly recapitulated.

It is cheap in first cost; it has a very long range, and causes a very small drop in pressure.

It forms a most convenient combination with a demand indicator.

It will integrate any current, however small, with perfect accuracy. It requires absolutely no attention, and its cost of maintenance is *nil*.

The sense of security that such a meter should give to a central station engineer on the single point that every unit supplied to a customer is recorded, ought to, and is, removing the lingering objections which have hitherto attached to electrolytic meters as a class.

ELECTROLYSIS AND INSURANCE.*

By HUBERT SCHUURMAN WYNKOOP, M.E.

(Abstract.)

To no one is the subject of electrolysis of more vital interest than to the fire underwriter; and yet it is doubtful whether the average insurance man gives to the electro-chemical destruction of our underground metal work more than a passing thought.

In a broad sense, the process of electrolysis consists in the passage of an electric current through a solution of metallic salt, from an oxidizable metal to some other conductor, the salt being thereby separated into two parts; first, the metal, appearing at the negative electrode; and, second, an unstable compound of the remaining elements. This unstable compound is supposed to unite with the hydrogen of the water, liberating oxygen and forming an acid. Both oxygen and acid appear only at the positive electrode, which is thus made subject to a double decay—a corrosion by the oxygen and a solution by the acid.

A little study of the conditions existing in a trolley town will convince one that, theoretically, at least, gas pipes, water pipes, railway tracks and other artificial conductors are gradually disintegrating, and that electro-chemical action is a factor in accelerating the decay. These conductors are the electrodes. In contact with them is the soil, containing an electrolysable salt—chloride, nitrate or sulphate of ammonia, potash, soda or magnesia. Add to these moisture and electricity, and electrolysis is set in motion.

The moisture is the natural dampness of the soil; the electricity is the current of the street railway generator.

This view of the sub-surface electrical conditions of the town opens up enormous possibilities. The size and distribution of the elements of our gigantic cell require a correspondingly large supply of electricity; and it has been reserved for the grounded return trolley system, unfortunately, to demonstrate its ability to furnish current enough to carry on this deplorable electro-chemical destruction.

The ordinary trolley railway, then, is indisputably responsible for increasing our fire hazards; for, if the destruction of piping and other metals laid underground can be proven—and this involves no difficulty whatever—the disastrous results of this destruction speak for themselves.

* *Insurance Engineering* (of America).

The current of the street railway system, after passing through the car motor, is led to the rails, whence it is expected to find its way back to the power house *via* the rails—and, incidentally, *via* any other path or paths that may be available. With strict impartiality this "return current" divides itself up and travels the various paths, in quantities inversely proportional to the resistances encountered; and those portions of the current which do not confine themselves to the rails and the return feeders, but pass homeward along pipes, &c., are classed as "stray current," "vagrant electricity" or "trolley leakage."

Such is the theory, and, unfortunately, the practice as well. From all points of the compass are coming in complaints of the failure of gas and water pipes, the accompanying evidence indicating conclusively that the inception of electrolytic troubles was in each instance coincident with the placing in service of the electric street railway.

Our latest information indicates that no industrial metal is free from electrolytic trouble—given the proper conditions—and that cast-iron seemed to be safe only because it responded more slowly to the attacks of free oxygen and acid. Prof. Samuel Sheldon has shown that the retarded effect upon cast-iron is due to the "skin," which consists of a silicate of iron.

The ultimate breakdown of a water main cannot be predicted at the present day as in the past. Formerly, we might safely count on a life of 10 or 20 or 40 years for our cast-iron pipe. Now that electrolysis has been added to the ordinary process of rusting, the pipe life may be one year or 40 years, depending not only upon the character of pipe and soil, but also upon the unknown and shifting electrical conditions.

The failure of a water main cannot cause a fire, but the breakdown of a pipe used for the distribution of gas is a direct cause of fires which may originate under a number of conditions.

Several years ago it fell to the lot of the writer to investigate in detail the circumstances attending a "manhole explosion." The subway affected paralleled an electric street railway, being about 5 ft. distant from the nearest rail. Overhead was a steam elevated railway, while the street pavement consisted of granite blocks. In order to protect the lead sheathing of the cables from electrolysis, bond wires had been used to connect the armors electrically with each other, with the manhole head and with the rails. At the point of the accident some of these bond wires were found to have been disconnected, whether as the result of the explosion or not could not be determined; but an inspection of other manholes developed the fact that the bond wiring as it actually existed was favourably arranged to encourage a difference of potential between adjacent bonds, or between bond and lead, or bond and manhole head. Indeed, the attachment of a voltmeter to various pairs of points in one manhole secured readings ranging from zero up to 1 and 1½ volts.

The manhole cover at the point of explosion being without vents, the notion of a discarded lighted match was untenable; nor did it seem wise to saddle upon spontaneous combustion the responsibility for gas ignition so long as a more plausible explanation might stand in the foreground. So the report was made to state that the explosion was due, primarily, to an accumulation of gas in the subway, for which the gas company was responsible owing to leaks in its pipes, and for which the subway company also was responsible on account of its failure to so ventilate its subway as to care for the stray gas which was known to exist; and that, in the second place, the gas was probably ignited by an electric arc between two conductors at different potentials, which conductors were intermittenly jarred into contact by the vibration from a passing wagon or car. The writer further stated that, in his opinion, the difference of electrical potential was due largely to the stray current from the trolley system.

While the hurtling manhole cover can hardly be classed among fire risks, it is interesting to note that the back-flash of the explosion travelled along a subsidiary duct until it entered a nearby building, where a fire which ensued a short time after was subsequently attributed by many to the explosion in the subway.

In this instance the trolley leakage introduced a fire risk through the intervention of electrolysis; for the gas leakage was shown later on to be due largely to excessive corrosion of the gas mains, rather than to the ordinary leakage at the pipe joints.

The fire underwriter must perforce give due heed to the preservation of gas mains from the ravages of electrolysis.

Now these citations are sufficient to show that the proper disposition of the return current of the electric street railway constitutes a problem the solution of which is of much importance to insurance people. Day by day the danger is growing; and, notwithstanding all the investigations that have been undertaken and the palliatives that have been applied, the remedy has not been found. At present we are only temporising, fearing to banish the grounded return trolley, and hoping that at some early date a remedy for electrolysis and its kindred evils may be discovered. But when the fire insurance interests once become keenly alive to the destruction that is now going on there will be no further delay, no temporising; but, instead, prompt, decisive action. And, outside of processes at law, it is to the fire underwriters that the gas and water companies must look for relief.

MUNICIPAL TRADING.

In a letter which appeared in the *Times* of September 25th, Sir Frederick Bramwell expresses in no uncertain voice his views upon the question of municipal enterprise in connection with the production of "Mond gas." It appears that when in the recent session of Parliament the Mond Gas Company sought Parliamentary powers to supply gas in a district which comprised the areas of 27 distinct local authorities, no less than 12 out of the 27 petitioned against the Bill. Of these, seven were municipal traders in gas for illuminating purposes, while the remaining five had their own electric lighting stations. They all opposed the scheme on the ground that the ratepayers had sunk their money in these various enterprises; that if a useful commodity such as Mond gas were available, the municipal enterprises would suffer, wholly oblivious of the great benefits which would be conferred on factory owners and others in a district which comprises an area of, in Staffordshire and Warwickshire, some 135 square miles. We are happily able to record that this fatuous opposition met with no sympathy in either House, and that the Bill was successfully carried through.

We regard this as a good illustration of the tactics so often adopted by the advocates of municipal enterprise. Root and branch opposition to any scheme which trespasses upon ground which they have thought proper to annex for their own purposes, is their battle-cry. Here was an industry only just conceived, the promoters of which required, for the purposes of giving it a suitable test, a range of operations over a large area. That Mond gas can be produced at reasonable rates, and that it can be economically applied for the purposes of driving gas engines, and heating furnaces, has been amply demonstrated by Dr. Mond himself. Yet these local authorities must needs put their devoted ratepayers to the expense of opposing the Bill in Parliament.

Were it not for the serious check which is so often given to private enterprise by the continued extension of what some are pleased to term the "great principle" of municipal enterprise, one would almost feel inclined to treat with contempt the local authorities who are always clamouring for fresh powers, inasmuch as Parliament seems to have recognised even at the eleventh hour that, in relation to some provisional orders, the conduct of these bodies in delaying the execution of such orders has been objectionable. Thus, at a meeting of the Committee which was appointed to inquire into the whole subject of municipal trading, Lord Crewe said:—"On the question of electric lighting orders we have had a great many complaints from witnesses that local authorities, particularly the smaller ones, have obtained orders and have not used them." In answer to this, Lord Morley, chairman of Committee in the House of Lords, who was called as a witness in the Commons, said that he had heard the same complaints, and although the Board of Trade had power to revoke the orders, they used their power very sparingly. He suggested that there should be a limit put upon the time for the completion of the works, as in the case of a railway, and if at the end of that time the works were not completed, the undertakers should have to go to Parliament to ask for an extension. He further suggested that in order to obtain the time, they should have to bring good and distinct reasons, and failing their being able to do that, they should make room for somebody else. He also expressed the view that Parliament should lay down some definite rules as to how far municipalities should be allowed to trade, especially outside their own limits.*

We can only wait patiently for the report of some commission on the question of municipal trading, in order to see how far the Houses of Parliament will act upon the above very sensible suggestions. In the meantime we are faced with the fact that, in all directions, local authorities are seeking to extend their already extensive powers. Electrical fittings, for example, have been regarded as the lawful prey of enterprising bumbles, but we are glad to find that the Courts have decided that these articles cannot be manufactured by a local authority without the express consent of Parliament in that behalf.

In the case of the Corporation of Leicester *v.* Hill (the *Law Times*, Ap. 16, 1898, p. 559), it was decided by his Honour, Judge Wood, that a Corporation which supplies electricity merely under the Electric Lighting Acts, has no power to recover for the price of electric fittings, lamps, &c., supplied by it. By the Electric Lighting Act of 1882, Sec. 3, the Board of Trade may license any local authority to supply electricity for any public or private purpose. By Sec. 10 it is provided that the undertakers may, "for the purpose of supplying electricity, construct works . . . . enter into contracts, and generally do all . . . . such acts and things as may be necessary and incidental to such supply." It was contended before his Honour that internal fittings were incidental to the supply; but it is worthy of observation, and this point commended itself to the learned judge, that Sec. 18 provides that the undertakers shall not be entitled to prescribe any special form of lamp or burner to be used by any person, or in any way to control or interfere with the manner in which the electricity supplied is used. The learned counsel who argued the case on the part of the Corporation, drew attention to the fact that in one of the forms of accounts required by the Board of Trade to be filled up by the undertakers, there is an item, No. 6, in these words—"By sale and repair of lamps and other apparatus." Referring to this matter in the course of his judgment, the learned judge said:—"It certainly appears from that form that the person who drew it up contemplated that the Corporation would buy and sell lamps and other apparatus, and it may be that the Corporation have taken their cue from those words, and have taken to trading in lamps on the strength of them; but I am of opinion that a mere indication by a Government department that in its opinion a thing may be properly done cannot have the effect of authorising that which would otherwise be contrary to law; and as to Sec. 9 of the Act, it gives the Board of Trade no authority to authorise anything at all, but merely to prescribe the form in which the Corporation are to present their accounts 'of the undertaking' authorised by

* See the Electrical Review, July 27th, 1900, p. 135.

the Act, that is, the duty of supplying electrical energy. I am, therefore, of opinion that the contention of the defendant that the Corporation have acted beyond their legal powers in selling the articles named in the particulars is correct." We should add that although in this case the learned judge declared the conduct of the Corporation to be *ultra vires*, he nevertheless held that they were entitled to recover the price of the goods sold to and accepted by the defendant, on the ground that the plaintiff had got what he bargained for, and the fact that the Corporation were acting *ultra vires* had no effect to vitiate the contract.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

18,444. "Improvements in electro-plating apparatus." E. Phillips and T. Young. September 16th.

18,446. "The protected electric wire insulator." W. Sykes. September 16th.

18,483. "Improvements in the manufacture of electrical accumulators." C. T. J. Oppermann. September 16th.

18,502. "Improvements in electric arc lamps." R. Froment. (Date applied for under Patents, &c., Act, 1883, Section 103, February 16th, 1901, being date of application in France.) September 16th. (Complete.)

18,505. "Improvements in central station apparatus of telephonic installations with parallel branched subscribers' jacks." C. D. Abel. (Siemens and Halske, Actien Gesellschaft, Germany.) September 16th. (Complete.)

18,530. "Improvements in electric dynamos and motors." W. R. V. Marshall. September 17th.

18,531. "Improvements in electric dynamos and motors." W. R. V. Marshall. September 17th.

18,540. "An improvement in enclosed arc lamps." E. H. Johnson and E. S. Southwell. September 17th.

18,545. "Improved mode of attaching glass shades to electric light and the like fittings." J. A. Ellis. September 17th.

18,564. "Improvements in manholes and covers used in connection with electric cables and mains." T. H. Firth. September 17th.

18,569. "Improvements in incandescence electric lamps." J. R. Quain. September 17th.

18,576. "An improved alternating current electric motor." J. Bush and M. T. Mewday. September 17th.

18,577. "An improved push button controlled electric lift." J. Bush and M. T. Medway. September 17th.

18,578. "An electric controlling governor for the prevention of marine engines racing in a storm or heavy sea." J. Bush and M. T. Medway. September 17th.

18,579. "An alternating current brake for electric motors." J. Bush and M. T. Medway. September 17th.

18,597. "Improvements in electric regulating apparatus." The General Electric Company of New York. (J. A. Foote, United States.) September 17th. (Complete.)

18,598. "Improvements in alternating current electric meter." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) September 17th.

18,600. "Improvements in the treatment or manufacture of paper, applicable for use in electric insulation." J. B. Tayler. September 17th.

18,610. "Improvements relating to electric telegraphy." A. Muirhead. September 17th.

18,622. "Improvements in electric clocks." A. E. Conrady. September 18th.

18,626. "Improvements in trolleys for electric cars and the like." J. Linkleter. September 18th.

18,645. "Improvements in or applicable to pendants for incandescent electric lamps." W. R. Laidlaw and G. H. Scholes. September 18th.

18,652. "Improved means applicable for use in breaking electric arcs." T. von Zweigbergk. September 18th.

18,658. "Improved insulator for electric wires." J. E. Sharpe. (Date applied for under Patents, &c., Act, 1883, Section 103, May 17th, 1901, being date of application in United States.) September 18th.

18,682. "An improved electro-magnetic motor." D. Perret. September 18th.

18,691. "Improvements in and relating to electric switches." A. D. Smith. September 19th.

18,732. "Improvements in contacts for electric glow lamps." Electric Lighting Boards, Limited. (A. Lefebre, France.) September 19th.

18,743. "Improvements in electric wires or conductors applicable for use in electric railway or tramway systems, and in trolley or like current collectors therefor." G. Allan. September 19th.

18,787. "A new or improved electrical hauling apparatus, applicable also to other purposes." T. Greensmith, M. B. Wild, and F. Kidd. September 20th. (Complete.)

18,795. "Improvements in electric lighting by low frequency currents." The British Thomson-Houston Company, Limited. (W. C. Fisch, United States.) September 20th. (Complete.)

18,814. "Improvements in connection with the electrical actuation of toys." W. Dunn. September 20th. (Complete.)

18,830 "Automatic electric fire-alarm." W. J. Brewster. September 20th. (Complete.)

18,831. "Improvements in electric telegraphs for use on board ships, and for other purposes." Eversheb & Vignoles, Limited, and S. Evershed. September 20th.

18,879. "Improvements in and relating to electric tramways and the like." A. N. Connett. September 21st. (Complete.)

18,895. "Improvements in and relating to switches." S. Z. de Ferranti. September 20th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

24,792. "A new or improved method of and means for carrying and connecting strikers to motor vehicles for mechanically operating electric switches." W. Kingsland. Dated December 13th, 1899. Electric railways and tramways with mechanically-operated switches. The strikers for operating the switches are mounted so as to be maintained in proper relation to them. In one form the striker is mounted on the axle of a small auxiliary wheel having longitudinal play in its bearings which are spring mounted in horn plates of a frame attached to the vehicle. In another it is shown mounted on one of the ordinary wheels. Springs allow some pivotal play, or a pin and slot guide may hold it rigidly in the direction of travel. 5 claims.

24,805. "Improvements in appliances for reversing the current in continuous current dynamos." Siemens Bros. & Co. Dated December 13th, 1899. Sparking preventing, field magnets. For the purpose of reversing the currents in the armatures of continuous-current machines at the moment of commutation, special bipolar electro-magnets are inserted in the spaces between the limbs of the field magnets. The reversing magnets are excited either by the armature current or by a separate current more or less proportional thereto; their narrow poles are directed towards the armature, and have their distance apart determined by the number of grooves in the armature and the description of winding employed. The cores of the reversing-magnets may be constructed of laminated iron, and provided with short-circuited windings for deadening the magnetic oscillations caused by the reversal of the currents. To reduce the additional flux through the armature windings, the poles of the reversing magnets may be set obliquely to the axis of the armature. 3 claims.

24,824. "Improvements in electric incandescent lamps." C. Howard. Dated December 13th, 1899. A bulb is made with a long neck which may be divided, and fused together again after a new filament has been cemented to the long leading-in wires. The neck is made with two oppositely situated round or other recesses to receive small metal cups. A bayonet or other cap fits against a shoulder on the neck, and has small holes corresponding in position to the small metal cups to receive melted solder or other material which is applied so as to fill up the cups and project through the holes in the cap. The cap is thus secured without cement, and can be removed if desired. 3 claims.

24,832. "An improved method of making commutators for electrical machines." F. Kaeferle. Dated December 13th, 1899. In making commutators, the strips or bars and their insulating plates are forced together radially by means of two or more taper-bored rings of diminishing diameter which are pressed on to the commutator in succession. When the last ring has been driven on and the parts secured together, the surface of the commutator is turned down inside the ring, and the loosened ring is then removed. 1 claim.

24,879. "Improvements in or relating to electrical conductors." W. H. Isherwood. Dated December 14th, 1899. Armoured conductors are formed in sections by placing the conductor on insulating supports in a metal tube, and filling the tube with insulating material. A mixture of finely divided paper and shellac, moistened with methylated spirit, &c., may be forced in as a plastic composition. The sections are jointed together either by facing the ends of the conductor, or by placing a sleeve over the bared ends of the conductors, the sleeve containing a plastic composition, and drawing the ends of the section together by a screw sleeve. 4 claims.

24,887. "Improvement relating to electric arc lamps." T. J. Digby. Dated December 14th, 1899. Arc lamps for stage lighting or other purposes. Variation in the amount of light emitted to a projecting lens or reflector is effected by moving one electrode out of line with the other, independently of their ordinary longitudinal feed, which may be automatic. 1 claim.

24,940. "Improvements in auto-motor trolleys for electrically-driven vehicles." L. Lombard-Gerin. Dated December 15th, 1899. Relates to a self-propelled trolley collector for electrically-driven vehicles. The collecting wheels run on the feed and return conductors, and are driven by friction gearing from a motor which is suspended by pivoted links and springs from their axle. The trolley is connected by a universal joint and flexible cable to the vehicle, and the trolley motor is driven by a triphase current generated at the vehicle motor. In a modification for use with a triphase-current system, a third collecting wheel is mounted on springs on the trolley, to run under a third conductor, and the main current then serves to drive the trolley motor. Magnetic brake-shoes, excited from the main vehicle, are provided for the motor. 4 claims.

24,942. "Improvements in electric brakes." E. M. Tingley. Dated December 15th, 1899. Relates to electric brakes for rotating shafts, more particularly those of polyphase-current motors, wherein means such as springs are provided for automatically applying the brakes until they are withdrawn by two or more electro-magnets acting in line with one another, and energised by polyphase currents. 8 claims.

24,956. "Rotary field-measuring apparatus for uniformly loaded rotary phase current systems." Siemens Bros. & Co. Dated December 15th, 1899. Energy meters for equally loaded three-phase alternating current systems. Work done is measured in a meter having a rotary field produced by three pairs of coils on a laminated iron pole ring. One pair is in one supply main. Another pair is connected in series with an inductance coil, between that main and either of the other two mains, so that the current in it is nearly in quadrature with the pressure applied to it. The other two coils are wound parallel with the main current coils, and have their circuits closed either directly or through resistances; the resistances, or the inductance, are adjusted so that the resultant magnetic field due to the coils lags approximately 30° behind the main current in the coils when the load is non-inductive. The coils may be dispensed with, a large non-inductive resistance being connected in parallel with the main coils. A condenser may be substituted for the inductance. 1 claim.

24,960. "A method of producing electrodes for electric accumulators." C. Lucknow. Dated December 15th, 1899. Consists in "forming" in extremely dilute aqueous solutions of the hydrates of the alkaline or alkaline earthy metals. The plates or electrodes before treatment in this solution are grooved, roughened, or the like on the surface. The spongy lead plates which are formed by this treatment are lixiviated with water and pressed between rubber rollers. 1 claim.

24,968. "Process for the production of thermo-electric batteries." B. Jonas. Dated December 16th, 1899. The battery consists of a support of porcelain or other insulating material formed with a helical thread upon it, and having deposited between the threads and on opposite sides of the support two layers of different metals, the ends of which overlap or abut and form a joint. A number of elements, such as are described above, are arranged so that they can be heated on one side and cooled on the other. 1 claim.

25,032. "Improvements in electric driving mechanisms for geared machines generally." F. S. Carter. Dated December 18th, 1899. Relates to electric driving mechanism for geared machines generally, *e.g.*, cranes, winding machinery, hoists, calenders, printing machines, tramcars, and the like, and consists essentially in constructing either the field magnets or the armature of the motor as part of the gearing, thereby reducing the number of parts. In the application of the invention to a crane, hoist, or winding machine the barrel or winding drum forms also the yoke of the field magnets of the motor, the poles being either formed integral therewith or secured thereto; it is supported by means of hollow shafts in bearings on the framework. The armature, which may be of ordinary construction, runs in bearings in the hollow shafts and transmits a reduced motion to the drum through a pinion, spur wheel, intermediate shaft, pinion and spur wheel. 8 claims.

25,282. "Improvements in earthing devices and safety fuses for electrical circuits." L. J. Steele. Dated November 20th, 1899. Relates to apparatus for connecting a circuit to earth, should an abnormal current arise. 4 claims.